HANDBOOK

ON

ELECTRO-PLATING

. . POLISHING

. . LACQUERING

. . BURNISHING

. . ENAMELLING

SEVENTH EDITION

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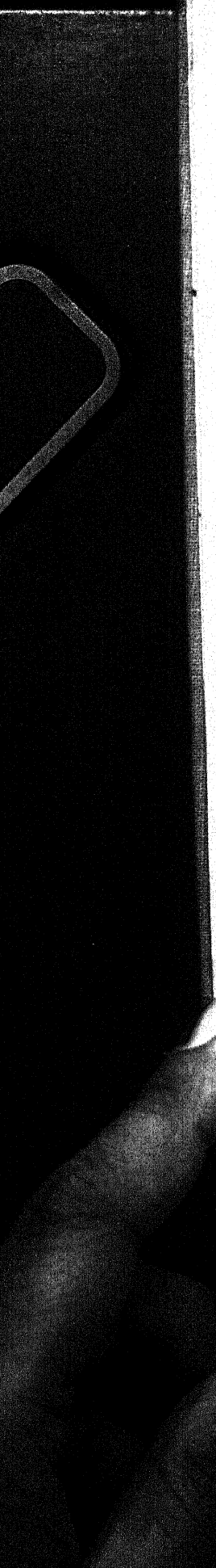

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APPENDIX. See end of Vol.

INTRODUCTION TO SEVENTH EDITION.

THE success attending the issue of the previous editions of this work has given us every encouragement to extend it, and to bring into notice the most modern methods and appliances.

Since the last edition was published several great improvements in Electro deposition, and the process of cleaning, preparatory to the actual plating, have been introduced; but as it will naturally be some time before these improved methods will be generally adopted, we have merely revised the instructions as to general plating and treated the later methods in separate articles (see pp. 43 to 131).

We strongly advise our readers to peruse and study these articles, as we are quite sure the economy in time occupied in executing the work, and space reduced for plant, will appeal strongly to every one.

It may be stated at once, that with ordinary care and judgment none of the common processes in Electro-plating are beyond accomplishment by anyone after a little necessary practice. It is only in special branches of the trade that much technical skill and knowledge are required.

Aim of this Work. It will be the aim throughout these pages to set forth in detail the practical means which are at present adopted in this country for the electro deposition of various metals, and the preparation and finishing of same.

It is not intended to introduce minute scientific detail, or enter into a complete account of the chemistry of electrolysis, but rather to afford a handy book of reference, and to have at hand, in case of need, recipes for the making of fresh solutions or hints for putting troublesome ones right.

Prominence will be given to the methods adopted in Nickel-plating, with special reference to the Cycle Trade.

Nickel-plating is carried on to a far larger extent by manufacturers, in connection with their other processes, than any other branch of electro deposition.

Further, the quantity of Nickel-plating is far in excess of all other branches.

Points to Remember. It is important to bear in mind that the scientific basis by which Electro-plating is carried on is the same throughout, whether conducted by an amateur or the largest electro-plater. The Apparatus is varied in accordance with the requirements of the work, but the principle of working remains the same; so it follows that the same instructions apply, whether large or small quantities of work are being operated upon.

As previously mentioned, the utmost care must be constantly exerted in carrying out the work. Electro-plating has so largely to do with Chemicals that if careless means are adopted, continual difficulties are likely to ensue.

Purity of Chemicals. It must be borne in mind that it is absolutely necessary, in all branches of Electro-plating, to use pure Chemicals.

Electro-platers, even if they knew how, could not make the chemicals used as cheaply as they can be bought from manufacturers who make a speciality of Electro-plating Chemicals; but the utmost care should be exercised to ensure the purity of one's supplies, as prices, in many instances, are no criterion of value, and the chief safeguard in this matter is to trade with firms having established reputations at stake, who can be depended upon, in their own interests, to supply pure Chemicals.

Difficulties continually occur in the use of impure Chemicals, especially in Double Nickel Salts and Cyanide of Potassium, two Chemicals enormously used in electro deposition.

Cyanide Potassium must be recognised as the most important substance used in electro deposition.

When the Double Salt of Potassium and Sodium and later Cyanide of Sodium came into use, consequent on their manufacture for gold extraction, by which Cyanides carrying a high percentage of Cyanogen were obtainable, they were largely adopted for use in electro-plating, as it was argued that it was the Cyanogen that did the work and its origin was unimportant. This apparently flawless theory was gradually dispelled, as it was observed that the more conservative workers who adhered to the use of the Potassium Salt obtained better results, this being particularly noticeable in French practice and the work of the older English platers.

When a genuine white Potassium Cyanide testing 95 per cent. was produced, it was at once favoured, but in spite of its good colour it had the inherent defect of the earlier Cyanides of holding in suspension to a slight extent impurities in a finely divided state. The removal of these minute particles, by decantation and gravitation, is only partially successful with a resultant loss of Cyanogen, but at last, by operating on larger quantities, a concentrated Cyanide of Potassium was obtainable, testing 95 per cent., entirely free from Sodium, Sulphides, and other Sulphur compounds, of a light grey colour when viewed by reflected light, due to its complex crystalline structure.

From long experience we recommend Canning's Grey True Potassium Cyanide ("Zonax" Brand), 95 per cent. The plater is not troubled with

those unaccountable black patches, neither does he need to suspend his anodes in calico bags owing to his silver falling off like flour—the result of Sodium—and in practice it is found more economical even for cheap work.

Electric Current. Throughout these pages the Dynamo will be treated as the current producer.

Through the great advantages in the use of gas, oil, and electricity, power is easily obtainable everywhere for the efficient driving of the Dynamo and the necessary Polishing Lathes.

Batteries are not practical for use with any Nickel-plating Plant for a medium output of work, and to attempt the Nickel-plating of cycle work with Batteries is to court constant expenditure.

Batteries are still used for Gilding, Silver-plating, Nickel-plating, and Electrotyping, where only a small amount of current is required.

A chapter will be devoted to the management of Batteries; but owing to the constant expenditure on acids, zincs, and porous cells, the disagreeable fumes, and the gradual decrease of current in working, all involved with the use of Batteries, it can at once be seen wherein lies the ultimate economy in the use of Dynamos, and the gradual extinction of Batteries accounted for.

Catalogue of W. Canning & Co. The Catalogue of Electro-plating and Polishing Machinery and Materials issued by Messrs. W. Canning & Co. should be kept for handy reference in conjunction with this work.

The various articles mentioned and illustrated herein are to be found in that book with prices, and the numbers printed after various items in these pages are those corresponding with the items in the Catalogue.

SIZE OF PLANT, ARRANGEMENT OF PLATING, POLISHING AND FINISHING SHOPS.

Size of Plant. It is hardly possible in these pages to give fixed data for Plant to do particular work. The conditions are ever varying; one man may require a Plant to do a certain quantity of work per week in the best style and finish, and another to do the same quantity in a cheaper style and finish, when smaller Vats and fewer Lathes are necessary in the latter than in the former case. It can at once be seen how impossible it is to give practical data to suit all cases, or even a proportion of them.

The safest and best way in deciding upon a Plant is to apply for a detailed specification to Messrs. W. Canning & Co., who make a speciality of the supply of these Plants.

The information which it is necessary to furnish is—

(*a*) The total quantity of work required to be plated per week or per day, or the greatest quantity of work required to be plated at one time.

(*b*) A description of the article to be plated, the metal required to be deposited, and the nature of the metal to be deposited on.

(*c*) The sizes and a rough sketch of the area available for the operations.

On receipt of the above, Messrs. W. Canning & Co., at any time, are prepared to send an exact estimate of what is required, and, when desired, a plan showing the arrangement recommended for the different items in the Plant.

The size of Plant is in the main dependent (after the quantity of work required to be operated upon is known) upon the quality of the plating and finish desired, which is ruled by the length of time the work has to be left in the Vats, and by the care exercised in polishing, preparatory to plating.

Room for Extensions. In deciding upon a Plant, it is prudent, where possible, to leave room both with the Dynamo and the shops for further extension of the Plant at some future time.

Average Sizes of Plants for Cycle Work. The following approximate details of Plants for turning out various quantities of complete sets of cycle fittings per week are given on the basis that the work to be done is to be of the highest grade. This means that the work should remain in the Nickel Vats for from two to three hours, but when mechanical agitation or circulation of the solution or "Nivo" solution is employed, when the time employed is reduced by one half. Should cheaper coats of nickel be desired, the Vats can be reduced in size in proportion as the length of time for

deposition is shortened; or, on the other hand, for cheaper finish more sets per week may be turned out in proportion with the following Plants :—

20 to 30 Complete Sets of Cycle Fittings per Week (Outfit No. 52D) :

Dynamo, size O. P. X., with current to spare for extension when required.

Nickel Vat, 4 ft. × 2 ft. × 2 ft. deep.

Copper Vat, 30 ins. × 18 ins. × 18 ins. deep.

1 Polishing Lathe.

50 Complete Sets of Cycle Fittings per Week (Outfit No. 53F) :

Dynamo, size O. P. X., with current to spare for extension when required.

Nickel Vat, 5 ft. × 2 ft. × 3 ft. deep.

Copper Vat, 36 ins. × 18 ins. × 18 ins. deep.

2 Polishing Lathes.

80 to 100 Complete Sets of Cycle Fittings per Week (Outfit No. 54D) :

Dynamo, size O. P. A., taking all electrical output, or Dynamo, size O. P. B., with current to spare for extension when required.

1 Nickel Vat, 8 ft. × 3 ft. × 2 ft. 6 ins. deep, or 2 Nickel Vats, 5 ft. × 2 ft. 6 ins. × 2 ft. 6 ins. deep.

1 Copper Vat, 4 ft. × 2 ft. × 2 ft.

The above particulars refer to the employment of still solution in the Vats. If "Nivo" Nickel solution or agitated "Zonax" Nickel solution is used, the output may be doubled, and twice the number of Polishing Lathes will be required.

4 Polishing Lathes, comprising one Coventry Pattern Lathe as illustrated hereafter, and three smaller ones.

If cycle rims are to be plated the Vat should be 3 ft. deep.

For particulars on Copper Plating, see p. 91.

Number of Polishers and Output of Work. Speaking generally, for best work a Polisher should be able to polish and finish about twenty complete sets of cycle fittings per week. Where a large number of Lathes are worked, and Polishing and Finishing are carried on in separate shops, usually three, and occasionally four Polishers are necessary for one Finisher. By polishing is meant the preparation of the work for Plating, and by Finishing the final polishing after Plating. In small Plants, such as used by small cycle agents, etc., one man is able to carry out both the Plating and Polishing.

The Shop for Polishing, Plating, Finishing, and Burnishing. A separate shop should be provided for each operation, but in small establishments the Polishing and Finishing may be done in the same shop.

The Plating Shop should be, wherever possible, on the ground floor, either bricked, cemented, or concrete, with the necessary face to allow the water to drain off into a gutter or drain constructed for the purpose; if a wood floor is used for the purpose, it is better to have it covered with lead where the swilling, scouring, and cleaning is done; in all cases Wooden Racks or False Bottoms (*See Catalogue, No.* 219) should be provided in front of the Swilling Trough, Cleaning and Water Tanks, also alongside the Plating Vats, for the operator to stand upon when at work.

The Polishing and Finishing Shops. These should be, if possible, entirely separate from the Plating Shop; but if all the operations are carried on in one Shop, a partition should be erected between the two.

Light. The Shops should be as light as possible, so that the workman can plainly see the progress of the work in hand, and that the Plater may quickly detect changes of colour with the work. Special care should be taken in placing the Scouring and Swill Trough in a good light. Plenty of light to the Plating Shop, especially where gilding, silvering, and bronzing are carried on, is particularly important.

Ventilators. Where much acid dipping is necessary, where batteries are used, where many hot cyanide solutions are being worked, or where

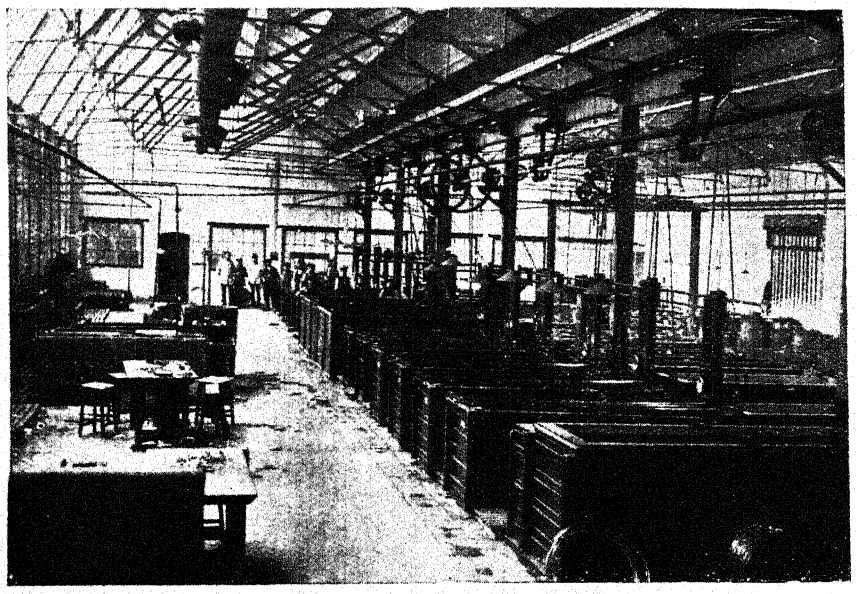


ILLUSTRATION OF A MODERN PLATING SHOP INSTALLED BY W. CANNING AND CO.

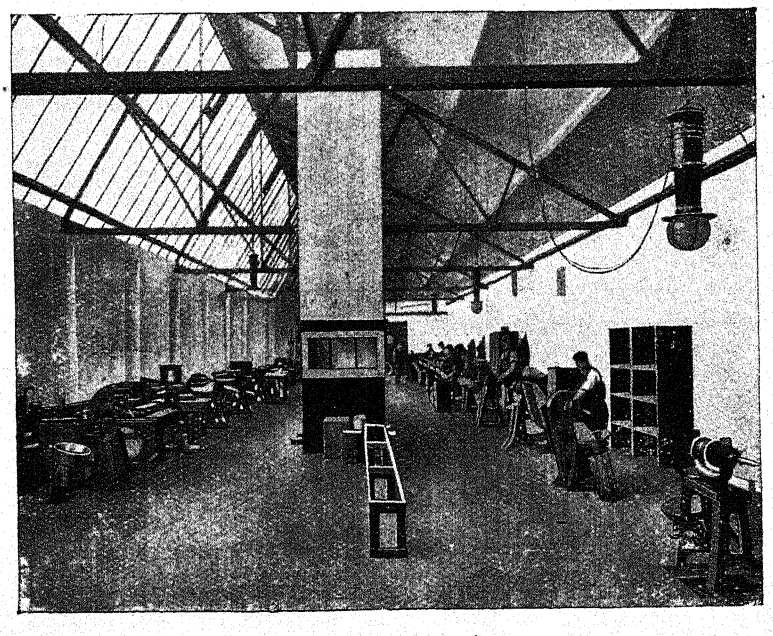
other obnoxious fumes are evolved, it is necessary to supply ample and efficient ventilation for the comfort of the operators.

In Polishing Shops. It is always advisable and now insisted on by the Government Factory Inspectors that ventilating fans should be erected for the removing of dust from polishing shops. The arrangements by which this is done are varied, as it depends upon the position in which the lathes are placed and also where the dust is to be drawn to. It is therefore always advisable to send a rough sketch of the shop, showing the position of the lathes, the size of the shop, and where the dust can be removed to.

Water. A plentiful supply of water is necessary where any Electro-plating operations are to be carried on.

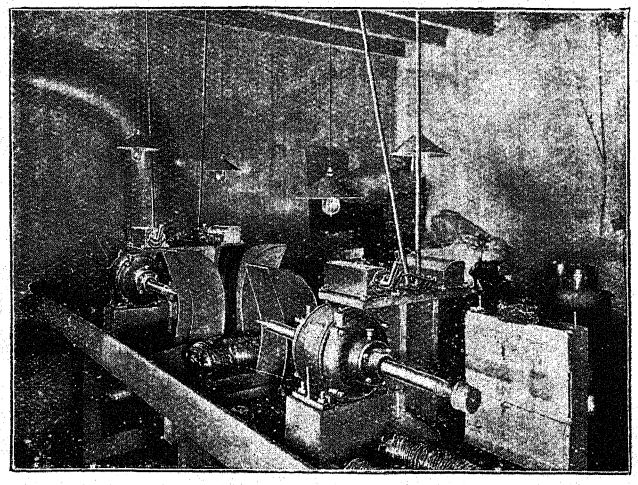
Heating Arrangements for Plating Shop. As in all operations different solutions and tanks have to be kept heated, arrangements have to be made either for Gas or Steam. For small plants Gas is sufficient,

but for larger plants Steam is strongly recommended, being far more efficient, economical, and handy in use.



MODERN POLISHING SHOP.

Plants for Silver-plating, Electro-coppering, Brassing, Tinning, Electrotyping, etc., vary so much, according to the articles to be plated, that it is almost impossible to give any exact data for each process,



SHOP SHOWING ELECTRIC POLISHING MOTORS.

but reference to our Catalogue will show outfits of various capacity to suit any requirement for each of the above operations.

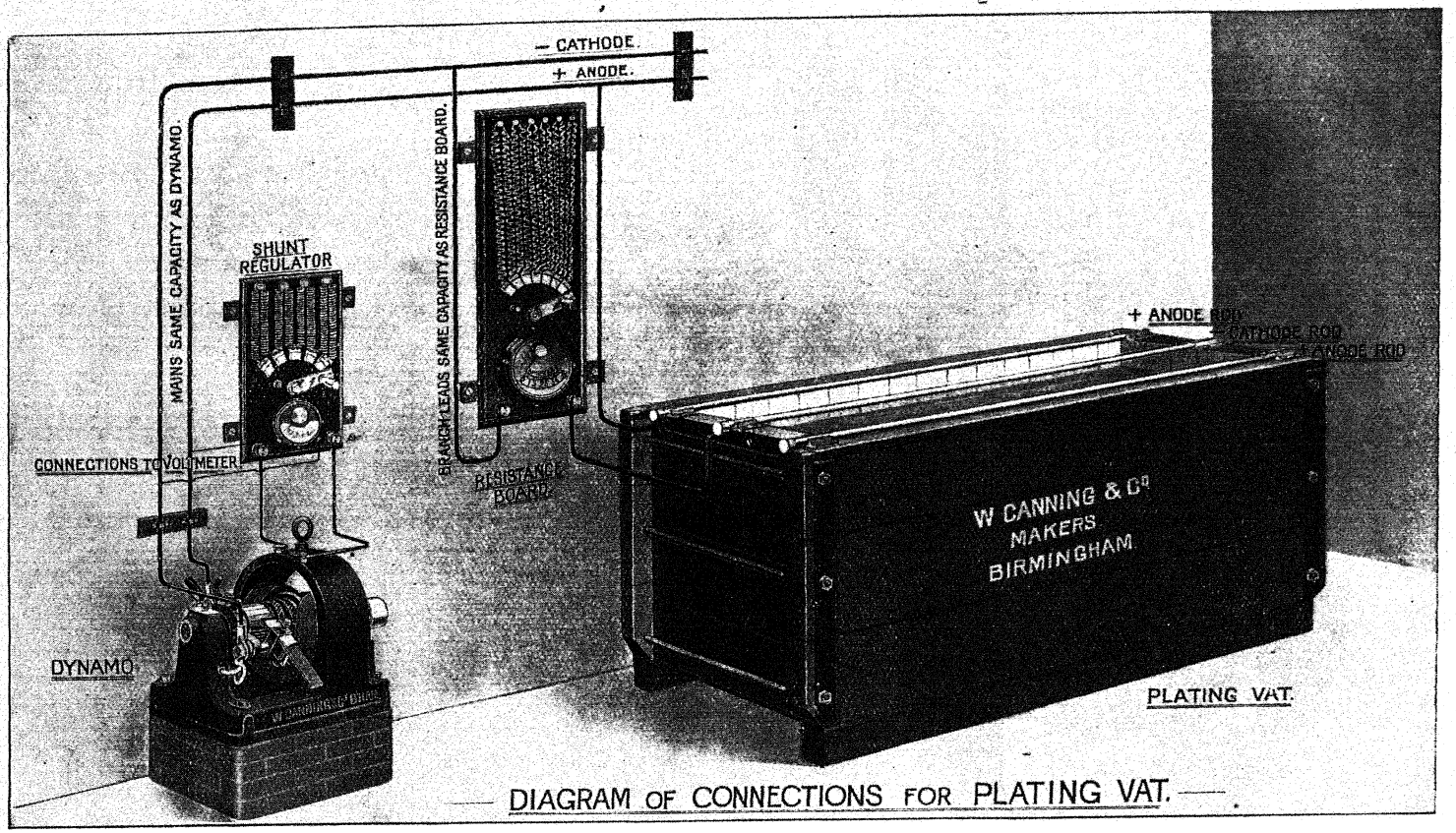
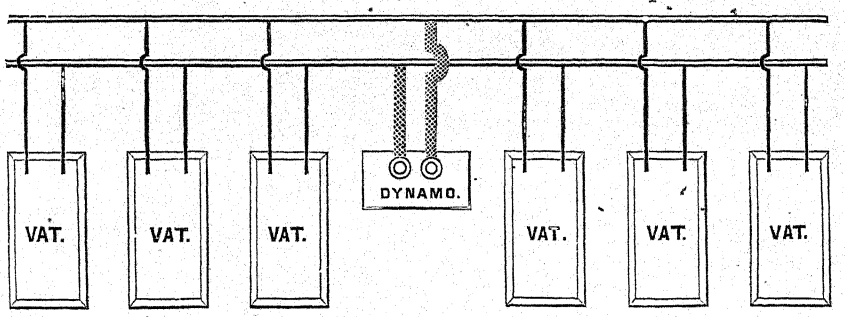


DIAGRAM OF CONNECTIONS FOR PLATING VAT.

FIXING AND ARRANGEMENT OF PLATING PLANT.

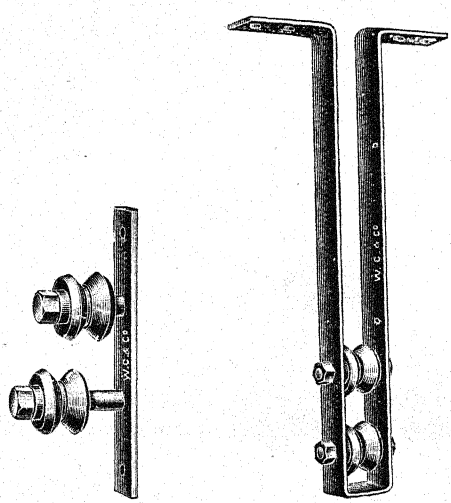
Position of Dynamo. To obtain the greatest quantity of electrical current for actual deposition, the Dynamo should be fixed as near as possible to the Vats. Where many Vats are in use, the position of the



Dynamo is of very considerable importance electrically, as the farther the machine is from its work the cost of conductors increases in proportion to the distance, or the greater will be the loss of current. Should several Vats be worked in one line, the Dynamo should be placed in the centre, as here illustrated, or as nearly so as can be arranged.

Usually, the exigencies of each case necessitate separate advice being given on this point by the contractors for the plant.

Terminals of the Dynamo. Details for fixing and working the machine being given later, it is necessary here to mention the positive and negative terminals on the machine, which are connected to the Vats. These terminals are usually marked + (positive) and − (negative), the + terminal being that usually connected to the top Brush-holders of the machine. Should these not be marked, connect one end of each



No. 239A. No. 239B.

BRACKET INSULATORS.

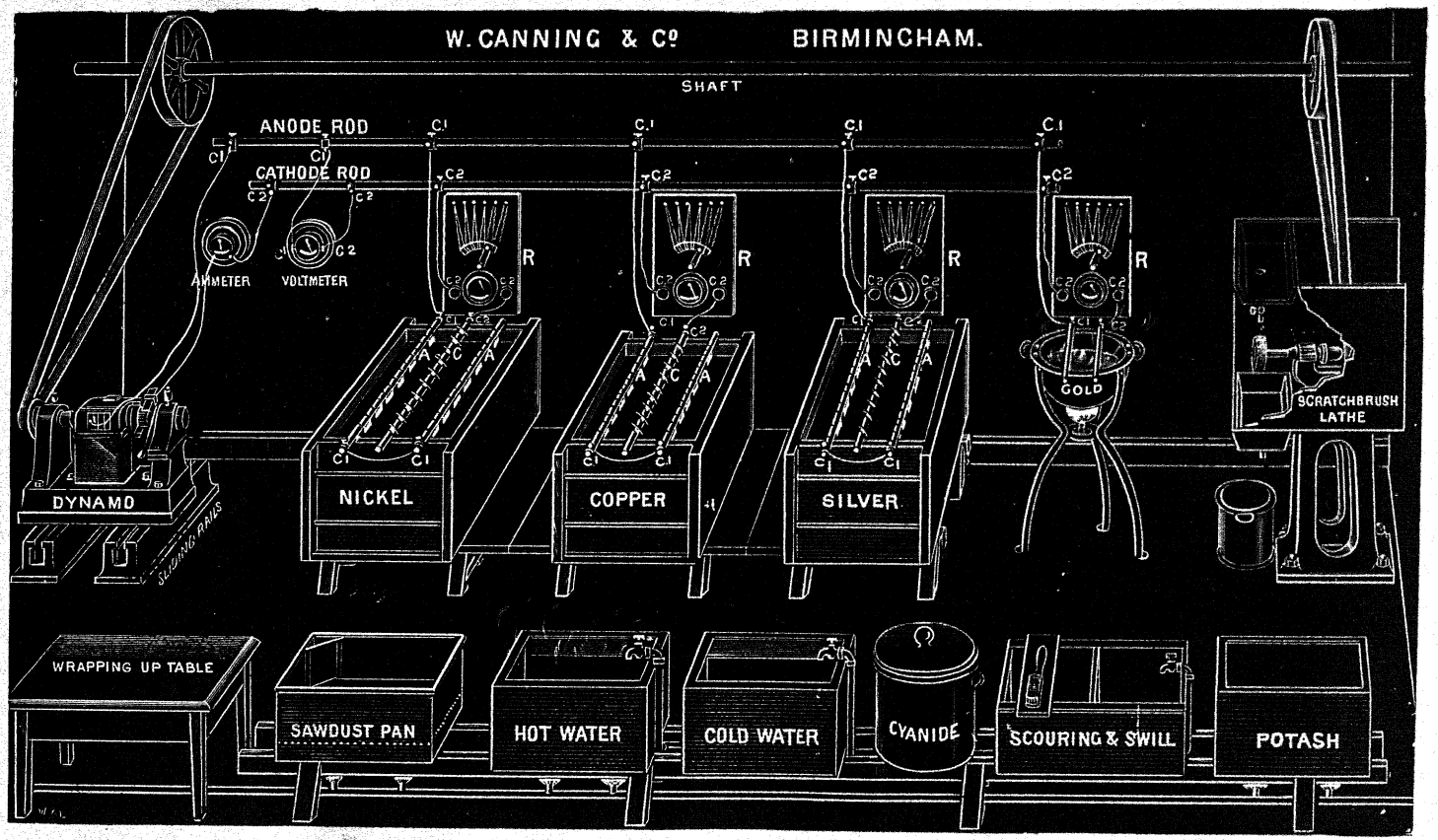


Diagram of Complete Electro-plating Plant.

(Showing at a glance the correct way a Plating Shop should be fitted up.)

of two thin wires to the terminals of the machine whilst running and place the other two ends in a bowl of the solution, but not in contact. The wire from which the gas rises will be the negative wire, and for connection to the work in the Vats, and the other terminal will be the positive for connection to the Anodes.

Connections and Conductors. In the diagram on the opposite page is illustrated the mode adopted when several Vats are worked in one Shop.

Solid rods of pure electrolytic copper (*Catalogue*, *No.* 246) of sufficient length should be fixed by suitable supports to the wall, or insulators (No. 239B) for carrying copper lead rods, for bolting to the ceiling or roof or (No. 239A) for fixing to wall. The Rods are made up to 18 feet in length. All joints should be soldered to prevent leakage of current.

The diameter of the Rods varies with the quantity of the current and the distance it is to be carried.

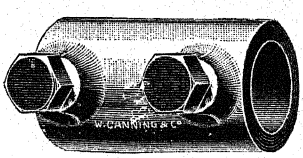
The following sizes of Rods are suitable for carrying the current, if the Dynamo is placed from 20 to 40 feet from the Vats—

$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$1\frac{3}{4}$	2 in. of solid copper.
200	300	450	600	800	1,250	1,800	2,400	3,200 ampères.

Heating of Lead Rods is invariably caused either by the Conductors being too small in diameter or bad joints in same.

If the Dynamo is over 20 ft. away from the Vats, the diameter of the Lead Rods must be increased proportionately to prevent waste of power generated. It will thus be seen how important it is to have the Dynamo close to the Plating Vats, both to save initial cost in Conductors and power in running.

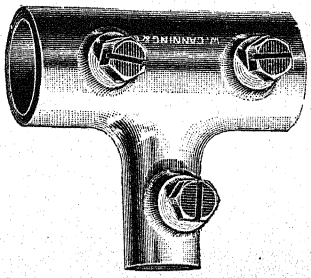
Should it be necessary to join the Rods, a straight Connection, as here illustrated, should be used.



STRAIGHT COUPLING.

The coupling must be sufficiently large to carry the same current as the Rods, and bored out just to fit the Rods.

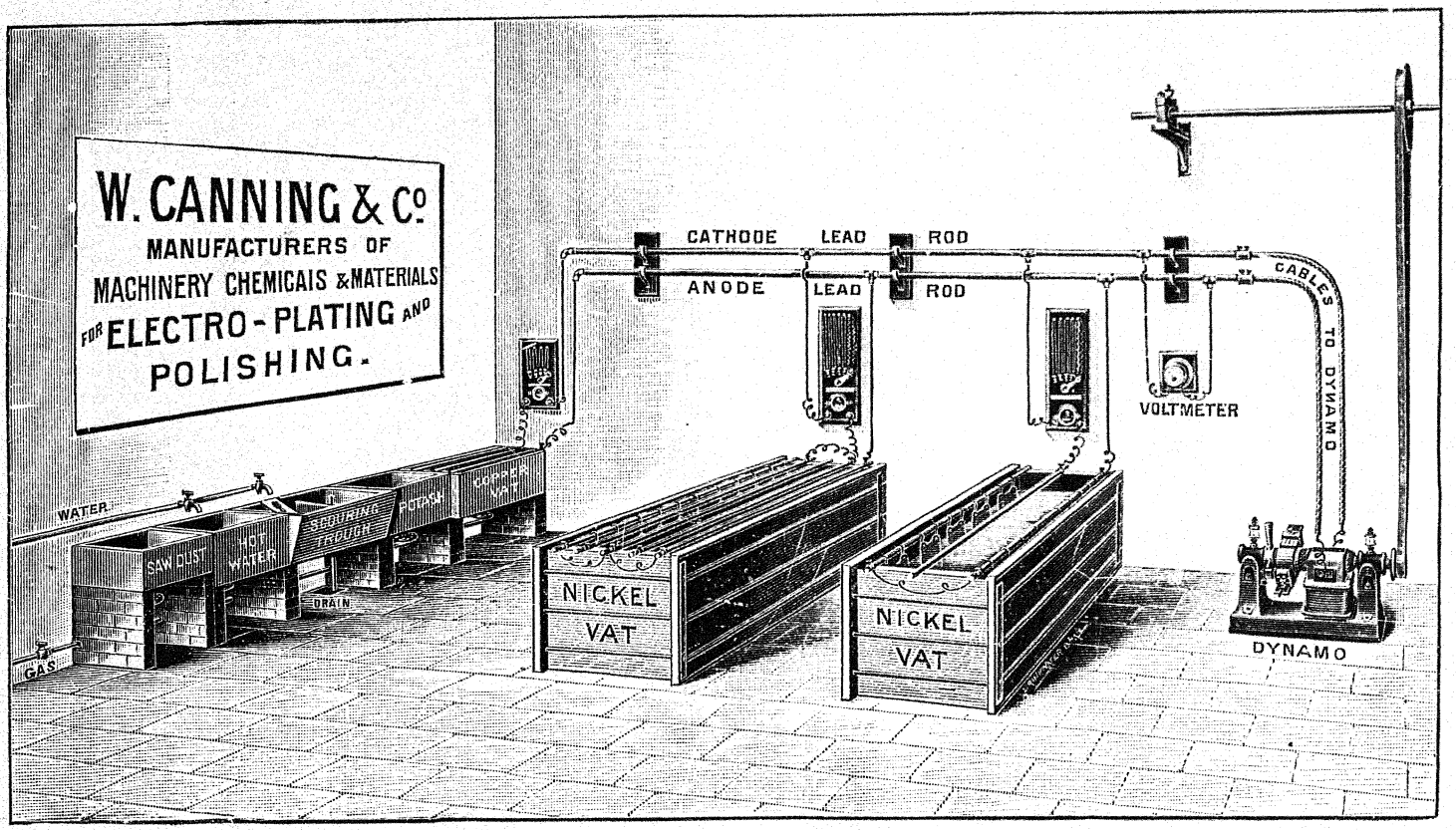
The ends of the rods must be brought flush together and the coupling soldered with soft solder so that no leakage takes place. Clamping screws are provided to keep the couplings in their proper position. Connections one on each Rod of T type for conveying current to the Vats should be attached to the rods.


T CONNECTION.

The Rods being now fixed, one is determined the Cathode Rod and the other the Anode Rod.

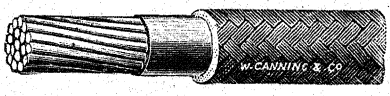
A coupling of convenient form, either straight, of T type or elbows, as here illustrated, must be placed at end of each rod for connecting same by Cable to Dynamo.

A length of cable (No. 43), made of several strands of copper wire and protected by insulation, is connected to the positive terminal of the


W. CANNING & Co
MANUFACTURERS OF
MACHINERY CHEMICAIS & MATERIALS
FOR ELECTRO-PLATING AND
POLISHING.
CATHODE LEAD ROD
ANODE LEAD ROD
CABLES TO DYNAMO
VOLTMETER
WATER
SAW DUST
HOT WATER
SCOURING TROUGH
POTASH
COPPER VAT
DRAIN
GAS
NICKEL VAT
NICKEL VAT
DYNAMO

Dynamo and to the Anode Rod. Another length of cable joins the Cathode Rod and the negative terminal of the Dynamo, a break being made for the current to pass through the Ammeter, as illustrated.

The connection of the Voltmeter should be carried out as in the diagram, and is mentioned in a succeeding chapter.



CABLE.

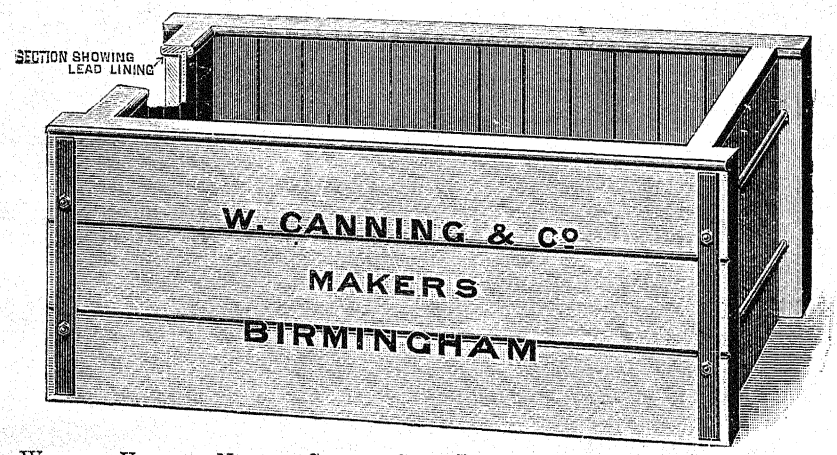
The connections to the Vats from the Rods are carried out by cable, as illustrated. The size of cable should be in proportion to the size of the Vat, as it only carries a portion of the current. The connection of the Resistance Boards is shown in the diagram from the Cathode Rods.

In small Plants the Copper Lead Rods can be dispensed with and the connection wholly carried out by the insulated cable.

Where Silver-, Brass-, or Copper-plating is carried on, a Scratch-brushing Lathe must be provided in the Plating Shop (see p. 92).

The diagram on p. 16 is that recommended for the arrangement of Nickel- and Copper-plating Plants for cycle work, etc. It needs no explanation, owing to its clearness, and a description of the other necessary parts of the Plant can be proceeded with.

The Plating Vat. For Nickel, Silver, Cold Brass, Cold Copper, or Cold Zinc Solutions, a Wooden Vat, lined with chemically pure lead with burnt joints and matchboarded, is used.

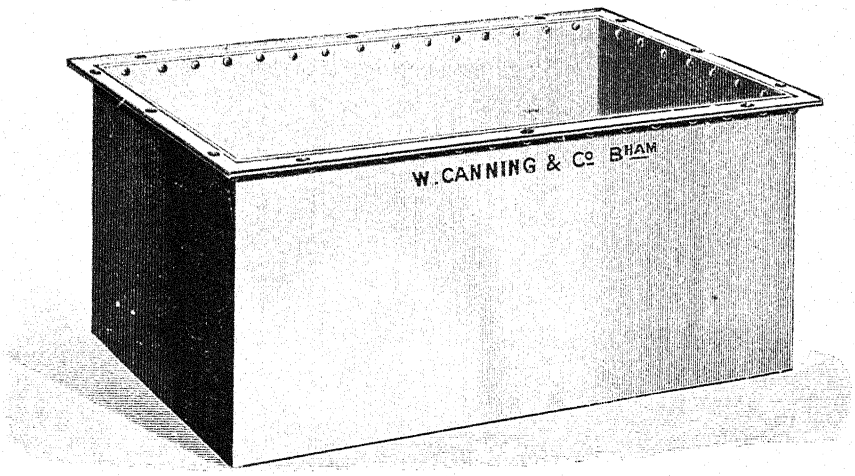


WOODEN VAT FOR NICKEL, SILVER, COLD BRASS, COPPER, OR ZINC SOLUTIONS. (*Catalogue, No.* 207.)

For large quantities of Silver Solution an Iron Vat lined with cement is sometimes used, or for small quantities an Iron Vat lined with special enamel.

For Hot Solutions of Brass, Copper, Tin, or Caustic Zinc an Iron Vat as illustrated is used.

The Vats for various solutions will be described in the pages where the solutions appear.



WELDED IRON SOLUTION VAT.

When an Iron Vat is used for Plating, a wooden frame should be placed on the top, and Earthenware Insulators fixed to carry the Rods, as illustrated below.

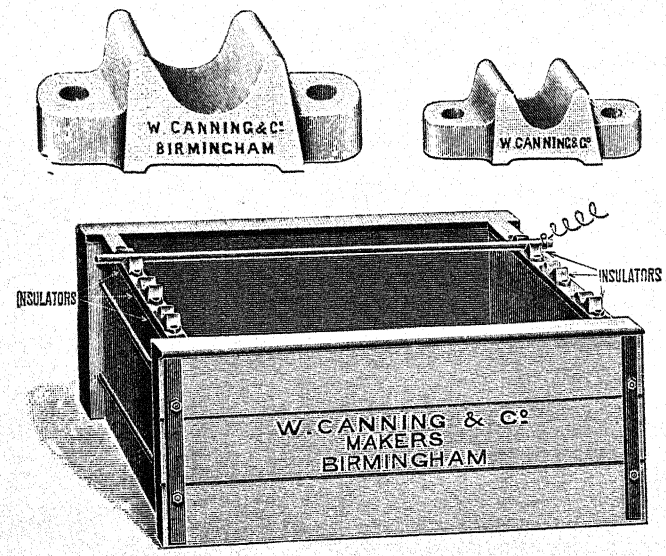


ILLUSTRATION OF VAT, FITTED WITH BRASS RODS, CONNECTIONS, AND INSULATOR.

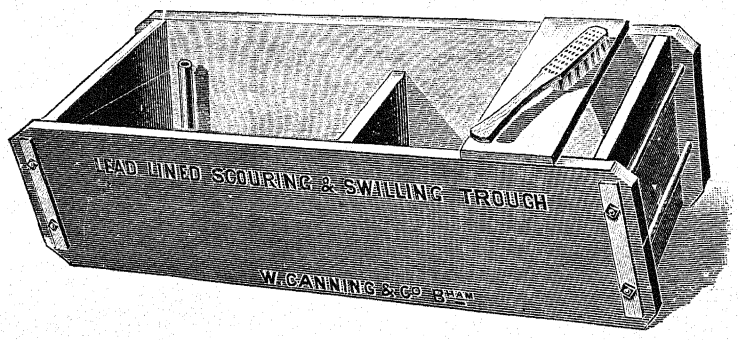
Prevents the current from creeping through the damp wood framing on Plating Vat.

Earthenware Insulators. These Insulators are also recommended for use on wooden vats, as there is always a danger of current creeping when the wood becomes saturated.

The Potash, or Cleaning, Tank (*Catalogue, No.* 212) must be made of iron (*not galvanised*), and the best quality is essential, owing to the constant heating required, as the solution must be kept at nearly boiling-point.

An angle-iron frame or brick foundation is advisable for these tanks, in order to prevent buckling.

They must not be painted inside.

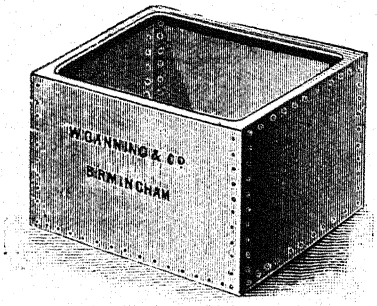


The Scouring and Swilling Trough (*Catalogue, No.* 230) is made with stout boards bolted together and lined inside with sheet lead. A constant supply of water from a tap or pipe should run into the Trough. A plug and overflow pipe are provided, and the water tap should be placed at the opposite end to the overflow pipe.

A wooden board or platform is fixed over the top of the Trough for the work to be scoured on.

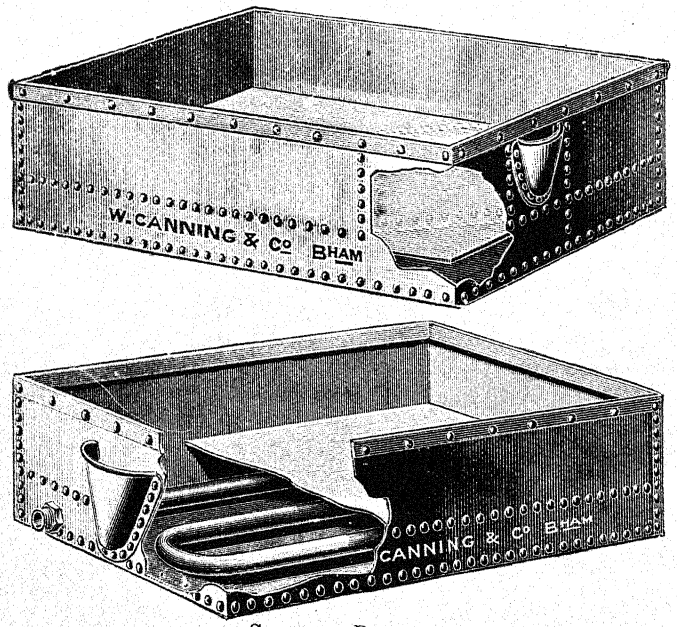
Dipping Pans (*Catalogue, No.* 313) of stoneware for different solutions are next necessary, and vary according to the work.

Hot Water Tanks (*Catalogue, No.* 231) of galvanised iron come next, and a water supply to same must be fixed



HOT WATER TANK.

Sawdust Pans (*Catalogue, Nos.* 233-5), made either of wrought iron for heating by steam, or galvanised iron for heating by gas. Where



SAWDUST PANS.

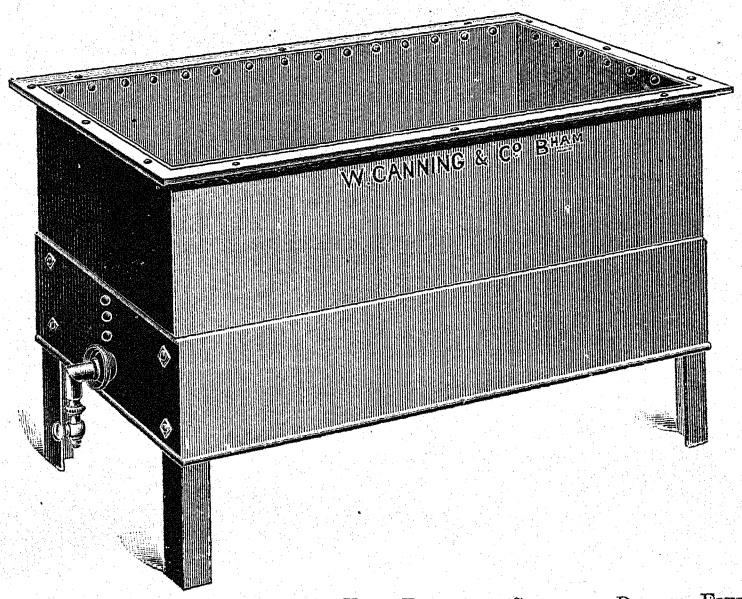
the latter is employed, the Pan is made with a false bottom to contain water, which prevents the sawdust being burnt.

On page 21 is illustrated a stand for Cleaning, Hot Water, and Sawdust Tanks, which are recommended in place of brick pillars. They are made in all sizes to suit our stock Vats and Tanks.

A bench must be provided for wiring up the work, if this is done in the same shop. In large establishments this is generally done in the warehouse or receiving room.

A Cupboard should also be provided for the operator to store his various chemicals, testing instruments, etc.

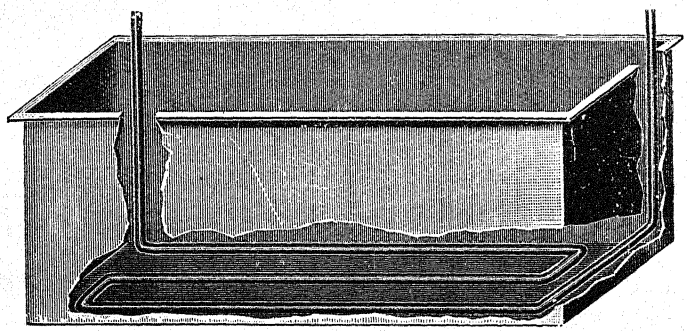
If Silver-plating or Gilding is done, or cast iron is Electro-brassed or Coppered, a suitable Scratch-lathe must be provided.



STAND AND BURNER, INTO WHICH VAT, TANK, OR SAWDUST PAN IS FITTED

The various Cleaning, Hot Water, Scouring Trough, and Sawdust Pans should be raised from the floor to a uniform height of 2 ft. 9 ins. at top.

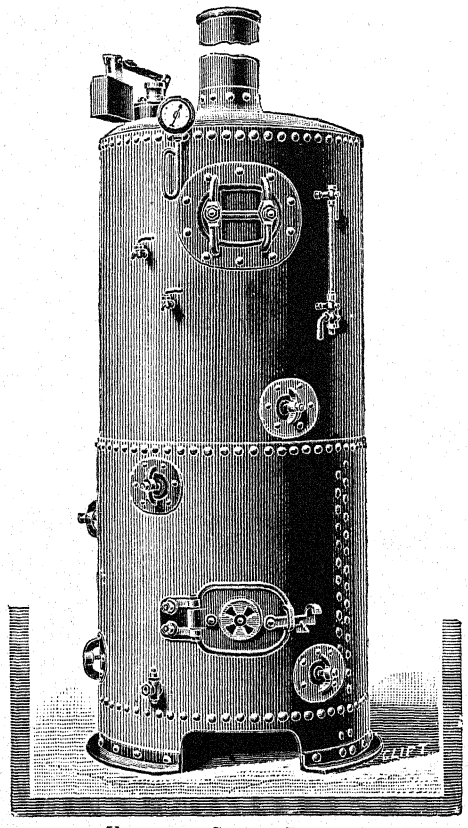
Heating of the Various Tanks. Where Steam is available, it can be used with great economy and cleanliness.



If taken direct from a boiler working at high pressure, we recommend coils placed at the bottom of each Tank. The number of pipes in coil should be arranged according to steam pressure and size of Vats or Tanks.

In places where there is no Steam available, we recommend the use of a small vertical Boiler, which should be placed outside, but as near as convenient to, the Plating Shop, with coils as previously described. The

Sawdust Pan is provided with coils (*See Illustration*, p. 20). For small Plating Outfits Gas is generally used for heating the Tanks. It is advisable to have a large main pipe to convey the Gas, and sufficient burners, so that the Tanks can be quickly heated and then partly turned off (*See Illustration*).



VERTICAL STEAM BOILER.

Always remember that the contents of the Cleaning Tank must be nearly boiling before plating can commence. In some instances where Gas or Steam is not available, Wood or Coal Fires are used, or Kerosene Lamps.

DRIVING POWER.

As the conditions and surroundings of different localities and works are so varied, it is impossible to give explicit instructions; but in this article it is our purpose to place before our readers a few suggestions and some advice as to the various motive powers, so that intending users may form an idea as to what is most suitable for them.

The first point to ascertain is the amount of power required, and to arrive at this, the size of Dynamo and the number and sizes of the Polishing Lathes to be driven should be determined.

For driving the Dynamo at an E.M.F. of 6 Volts, the power required at full load is as follows :—

Size	P42C	OPX	OPA	OPC	OPF	
	20	50	100	250	500	Ampères.
	$\frac{3}{140}$	$\frac{3}{4}$	$1\frac{1}{2}$	3	6	Horse-power.

For driving the Polishing Lathes we can give only an approximate idea—viz., for polishing small articles, $\frac{1}{2}$ horse-power for each Lathe ; but if the work is large, it would be well to calculate the requirement at $\frac{3}{4}$ to 1 horse-power for each Lathe.

In explanation of this, we point out that should the Lathes be 6″, 8″, 10″, our Nos. 360 N, O, or P, and small bobs and mops of 6″ to 9″ diameter be used, or even if a 12″ (360 Q) be used with small bobs or mops, $\frac{1}{2}$ horse-power per Lathe would be sufficient ; but if 12″ lathes 360 R, S, V, and W, sizes be used, with bobs and mops of 12″ to 15″ diameter, the estimate should be about $\frac{3}{4}$ to 1 horse-power per Lathe.

It rests, therefore, with the user, knowing the articles to be polished, to exercise his own discretion or obtain expert advice as to exact power required.

In all cases, however, it is advisable to provide such an amount of driving power as will be not only sufficient for, but in excess of, actual requirement, as it is well known that it is economy to work any engine or motor *below* its full capacity.

Having ascertained the horse-power required, the next point to decide is the best means of obtaining it, by using Electricity, Steam, Gas, or Oil.

This decision must, of course, rest upon the judgment of the user ; situations and surroundings which may be favourable to the use of one particular power in one place may be unsuitable to the use of that same power in a different locality.

Steam. In localities where coal is to be obtained very cheaply, where there is a plentiful supply of water, and where ashes may be conveniently disposed of, a Steam Engine and Boiler may be used with economy.

If Steam is adopted, provide sufficient boiler-power to heat the Cleaning and Hot Water Tanks, Sawdust Pan, etc.

Gas as a motive power has become so well known, and there are so many reliable engines on the market at a reasonable cost, that we make few remarks about them. They are convenient, and readily adapted to almost any situation.

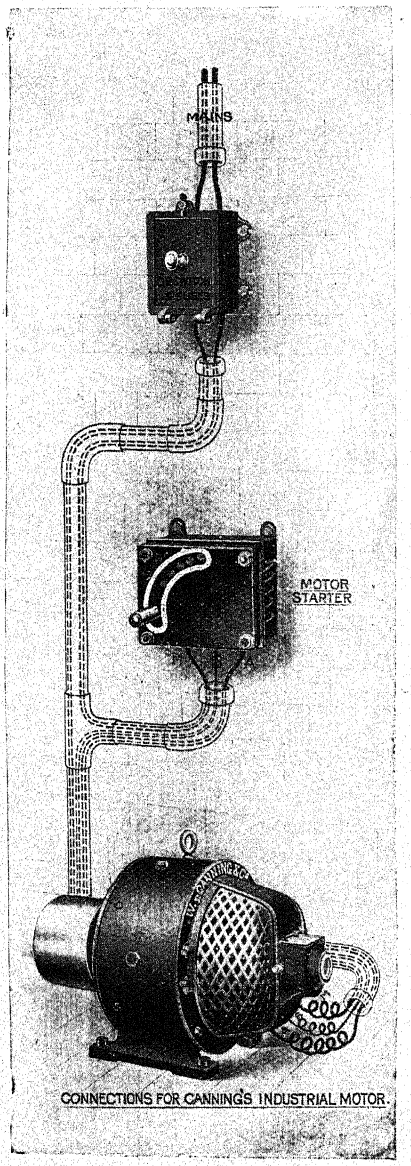
Electricity. The motive power, however, which is now rapidly coming to the front is Electricity.

In most of the larger cities and towns, Electricity is supplied from the public mains, and such progress is being made in the employment of this force that in a few years almost every town, and even the villages will be in possession of their generating stations and be in position to supply current.

The advantages of using this power are very great, cleanliness, ease

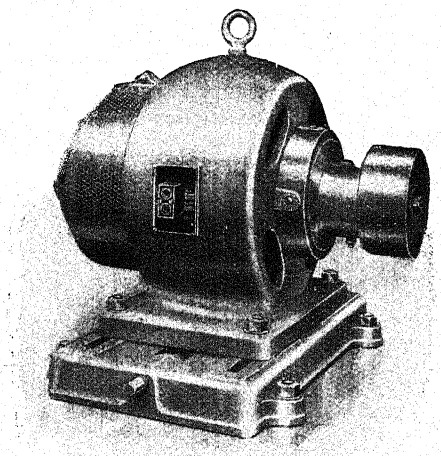
in starting and stopping, economy of space, and maintenance being altogether in its favour.

An Electric Motor requires lubrication on the bearings only, and in a well-made machine these are made so that no oil can escape, consequently they are always clean, no dust is raised, and there is no escape of objectionable gas or steam.



The floor space required is about one-sixth of that taken up by Gas Engine or Steam Engine (without the boiler) of equal power, and it may **be bolted to any firm floor without an expensive foundation.**

The stopping and starting is accomplished by the simple action of turning a switch.



PROTECTED ENCLOSED OR TOTALLY ENCLOSED TYPE ELECTRIC MOTOR

The economy of maintenance is in the fact that there are fewer bearings, and no cylinders or cranks to lubricate; they need not be started until the power is actually required for work, there is no water supply needed, and they do not demand the constant attention of an engineer. For particulars of Electric Polishing Motors see p. 194.

Oil and Petrol Engines are a very valuable addition to our sources of motive power, and for places situated in the country, the Colonies, or India; they cannot be too strongly recommended. They are now made very effective and reliable.

As to cost of working each or any of these power generators, we can give no actual data, and excepting in isolated districts, where Oil Engines are recommended, the choice must depend upon the judgment of the user.

It generally follows that in places where Gas is supplied at a cheap rate, Electric Current is comparatively cheap, especially for motive power, and in comparing cost of power, consideration must be given to the facts that an Electric Motor requires no water supply, that there is no time occupied in starting, and very little time taken up in cleaning, etc.

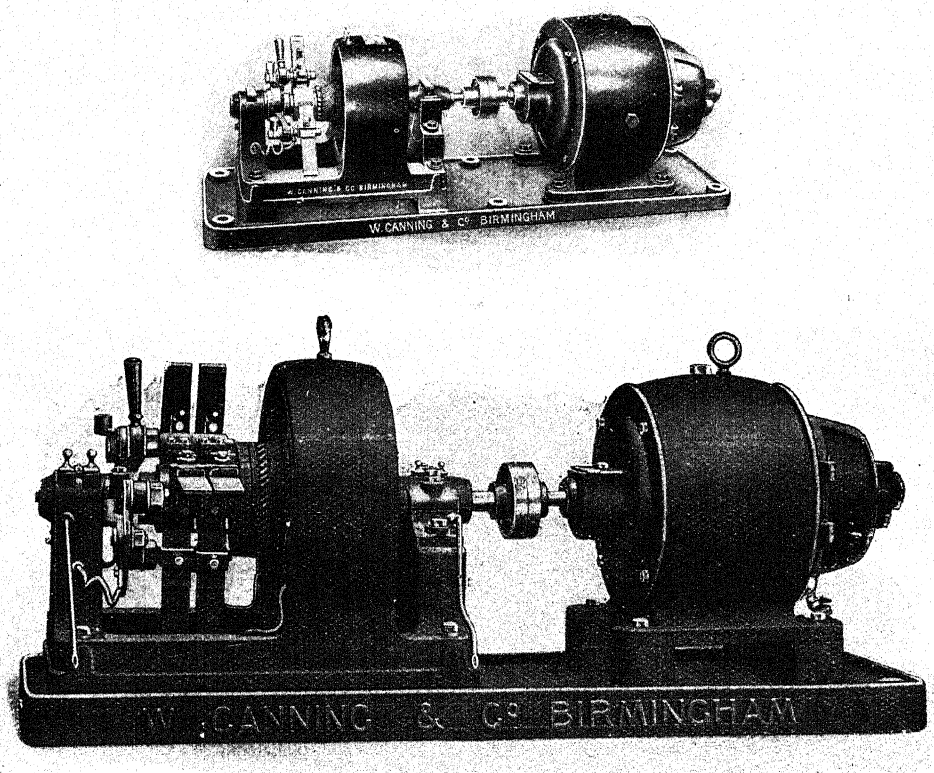


ILLUSTRATION OF MOTOR GENERATORS.

A most serviceable and convenient form of obtaining Electric Current for electro deposition, in places where Current from a main is obtainable, is by the employment of Motor Generators, which consist of a combination of an Electric Motor and a Plating Dynamo coupled.

The advantages are that the machine may be placed in plating shop, and connected by cables to the main, the switch is under the immediate control of the plater, and as there is no driving belt no dust is drawn into shop from the outside, and the speed is constant, there being no belt slip. It is also convenient that the Dynamo can be run and plating carried on when other parts of the works are idle (see p. 158).

THE BUYING, OUTPUT, FIXING, AND MANAGEMENT OF THE DYNAMO.

The Dynamo. All Electro-plating Dynamos are of the continuous current type, with an output of large quantity of current (denoted in Ampères) and of low pressure (denoted in Volts). This is the reverse of Electric Lighting Dynamos, which have an output of high voltage and low ampèrage. For this latter reason one Dynamo cannot be used for Electric Lighting and Plating, as is often desired. Where lighting currents are used, a Motor Generator may be run to transform the high voltage to a lower one suitable for Plating; and a most efficient method is to adopt the lighting current to drive an Electric Motor, which in turn should drive the Plating Dynamo and Polishing Lathes where required.

The Dynamos illustrated are the outcome of many years of practical experience in Plating Machines, and for perfection in construction and for durability are unequalled. They can be run continuously at full load without overheating and without a drop in the voltage—two most important items. The workmanship, both electrically and mechanically, is the best, thereby making the Machines of the highest efficiency and capable of giving their full output at a minimum loss for friction and self-excitation.

The Commutators are of best copper, and are particularly large, this being an important requirement often omitted in Plating Machines.

The Field Magnets are made of iron of highest magnetic quality, thus producing the greatest efficiency in the least space. The copper wire used throughout the machine is of 100 per cent. conductivity, well insulated, and of ample size.

The Armature or the Revolving Portion of the machine is constructed to prevent all dirt or other foreign matter entering it, and every precaution is taken to prevent any chance of burning out under fair conditions.

The General Winding of the machines is shunt, and any reversing of the current is guarded against. Compound Windings are supplied when required specially, but offer no advantage for general work.

The Brush-holders are adjustable for regulating the pressure of the Brushes, and are fitted with connecting strips or leads going direct to terminals, thus avoiding all loose contacts at the Brushes.

The Bearings, Shaft, and Connections are all of the best materials, and constructed with oil throwers and catchers to prevent the oil creeping.

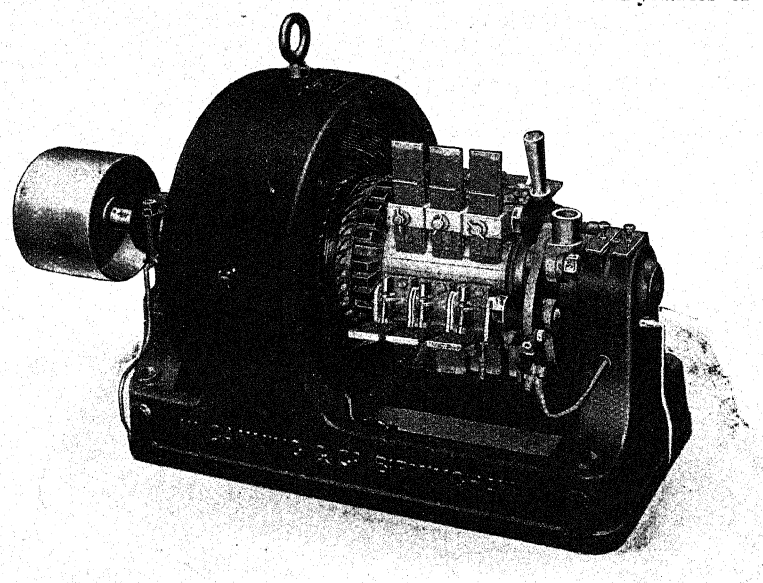
The matter of speed, an important item to be considered in buying a Dynamo, has received minute attention. Very high speed in a Dynamo means a lower price, but more frequent renewals, and shorter life than one of a moderate speed. Although machines with a moderate speed are more expensive to manufacture than high speed ones for the same output, the difference in cost is amply compensated for in the durability of the machines, particularly where in plating they are run continuously for many hours, and frequently receive rough usage.

Output. From the statistics given in another chapter it will be seen that the output of the Dynamo should be varied with the class of work to be done. Where silvering and electrotyping are carried on, the voltage

of the Dynamo need not be so high as where nickel-plating, brassing, and coppering is done; and it should be borne in mind that the statistics given are those at the terminals of the vats, so the voltage of the Dynamo has to be so much higher to overcome all the resistance in conductors, etc., from the Dynamo to the work.

Horse-power Required. As a safe margin it should be estimated that a Dynamo of 1,000 Watts requires approximately 2 Horse-power for driving. Watts are the output of the Dynamo in Ampères and Volts multiplied together. Thus a Dynamo of 250 Ampères at 10 Volts equals 2,500 Watts, requiring about 5 Brake Horse-power for driving.

Countershaft. A Countershaft should be used for Dynamos of any



SEPARATELY EXCITED DYNAMOS.

size. It is advisable to provide sliding rails for the base of large machines when an endless belt can be used.

Separately Excited Dynamos. The above is an illustration of one of our OP Type Dynamos, designed to have the field magnet excited by an outside or shop current, at any voltage, usually at 110 or 220 Volts direct current. The advantage of exciting the field by an outside current, is the control or variation which can be exercised over the voltage of the Dynamo at all loads.

In a Shunt Wound Self-Exciting Dynamo it is not wise to reduce the voltage by means of shunt regulation below 33⅓% at full load current output, but under similar conditions with a *separately excited machine the voltage can be reduced* 50% *to* 60% *on full load.*

The Voltage does not rise to any appreciable extent when the load is taken off, neither does it fluctuate as on a Self-Exciting Machine, when the speed is not constant, due to belt slip and other causes.

Where a direct current supply main is available, it is sometimes advisable to wind the Dynamo Field Coils to suit the voltage of such supply. The advantages of doing this are as follows:

1. The machine loses one of the characteristics of the shunt wound machine—viz., the current in the field windings can always be maintained constant, therefore the only voltage variation of the Dynamo is that due to the Armature Load.

2. The excitation is entirely independent of the current the Dynamo

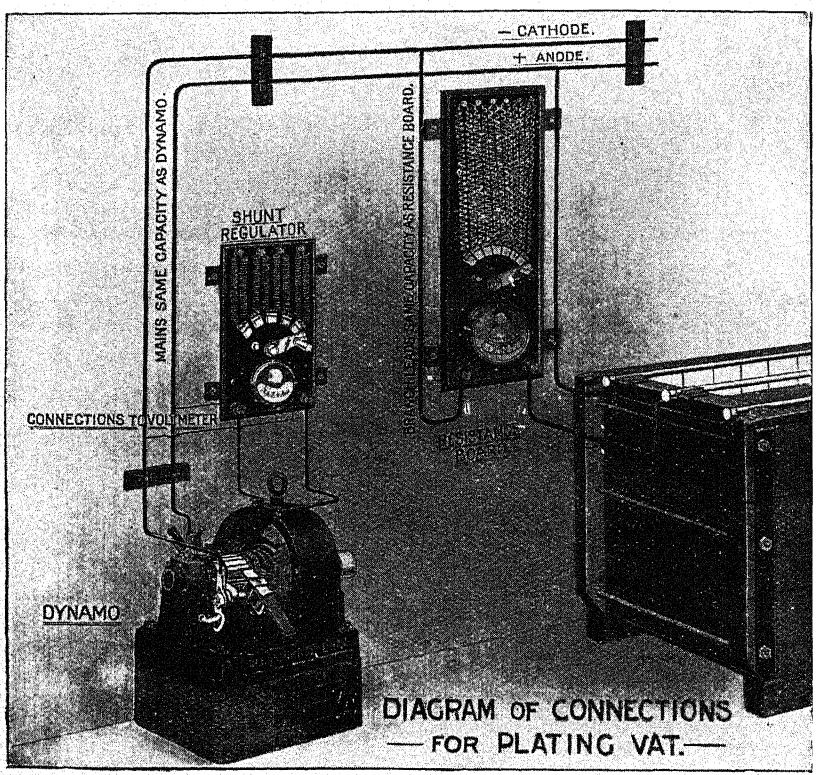


ILLUSTRATION OF SHUNT REGULATORS.

may be giving off, and therefore the voltage is not influenced so much by speed variation.

3. The shunt current is reduced to a very low value, therefore the Shunt Regulator is made up of very fine wire and large number ofcontact studs with increased flexibility of control.

4. It is not possible for a Dynamo to reverse polarity with separately excited fields.

Direct Current Motor Generators lend themselves admirably to separate excitation, the speed is almost constant, and the machines run with the generator voltmeter needle almost as steady as from a battery on discharge.

SHUNT REGULATORS.

ALL shunt-wound dynamos give varying voltages with fluctuating loads when running at a constant speed.

With a small load of work the resistance of the vat is high, consequently a very low current is taken off the Dynamo. Therefore the voltage at the Machine Terminals would be higher than that marked on the Test Plate, because that Test Voltage is taken at full load after a run of six hours, when the machine has reached its maximum temperature. When Shunt Dynamos are run for a long time with a small load the field coils become hot, due to the extra current flowing round them, caused by the

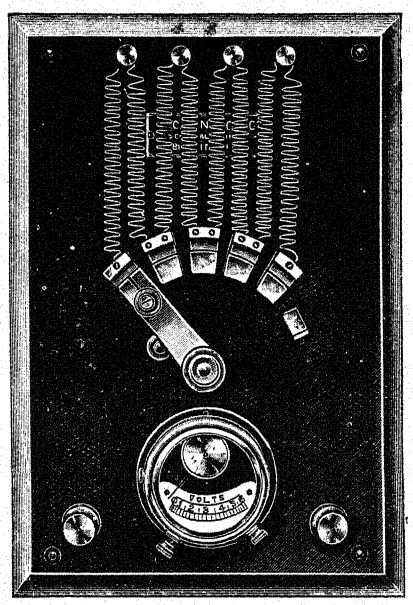


ILLUSTRATION OF SHUNT REGULATOR.

Dynamo Voltage being higher than the Full Voltage which the machine is made to produce. By the operator having an Adjustable Shunt Regulator he is able to maintain the shunt current at its normal value, and by this means regulate the machine to the voltage it was designed for under all conditions of load.

See that the Voltmeter is connected as illustrated on p. 28, or it will not register.

Shunt Regulators should be employed with Dynamos of 50 ampères and upwards.

CANNING'S DYNAMOS FOR ELECTRO-PLATING AND ELECTRO-TYPING, ETC., ETC.

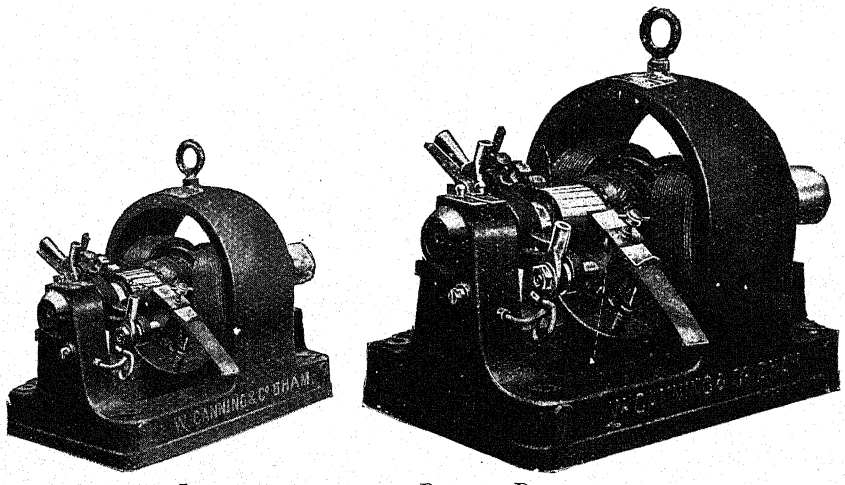
IN bringing before your notice our latest Type of Dynamos for Electro-plating, Electrotyping, and all purposes for which a low voltage is required, we have no hesitation in saying that our machines are the simplest and most reliable on the market.

Our machines are running on all classes of work, under all conditions, and in all climates. They are simple in construction, and give the most satisfactory results.

If our instructions are carried out with care, even in the hands of unskilled labour, there is no difficulty in working them.

To those who intend laying down an Electro-plating Plant, or are thinking of replacing their machine with an up-to-date Dynamo, we commend our "latest type," and feel sure it will be to their own interest to give it their careful consideration.

We are constantly making machines for various purposes; this leads us to have a large variety of patterns, and we can design and deliver at short notice machines of any capacity. We invite inquiries for these large type, low voltage Dynamos, having special facilities for their manufacture.



ILLUSTRATIONS OF OUR PLATING DYNAMOS.

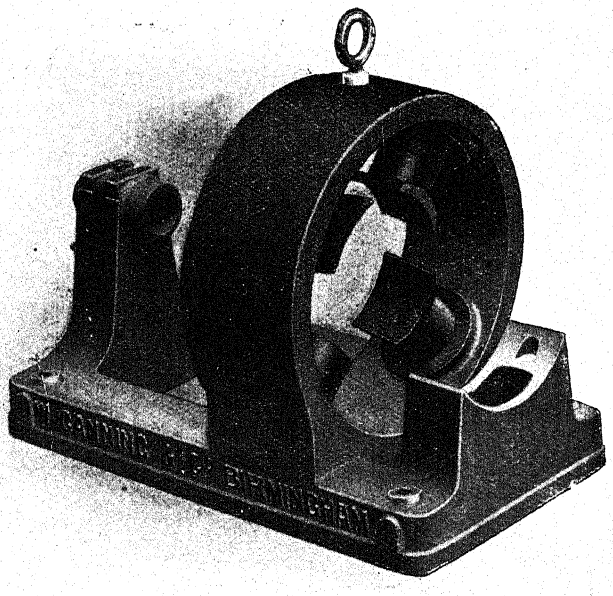
General Construction. The whole of the Dynamo Frame, which is also the magnet yoke, is cast iron of special quality and high permeability, and in one piece, having wrought-iron Poles or Magnets dovetailed in and cast in yoke.

Bearings are automatically lubricated by revolving rings running in oil wells, or fitted with Ball Bearings. The bushes are of solid gun metal of ample size to ensure cool running, and are easy of access for inspection. They are provided with the necessary holes for drawing off the oil when it requires renewing.

Magnets. The windings are so proportioned as to give the highest electrical efficiency, and are of cotton covered high conductivity copper wire wound on formers, built up with ends securely bound with tape, thoroughly insulated and coupled to terminals by heavy lead eyes soldered securely to ends of wire.

Pole Shoes. Are fixed to the pole faces by means of countersunk screws.

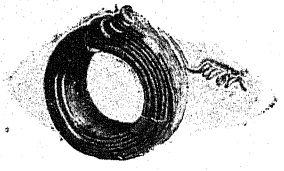
Terminals. The terminals are massive, and are placed in a convenient position on the dynamo. They are tinned ready for the Copper Conductor to be soldered in.



DYNAMO FRAME.

Shaft. Is of mild steel of ample strength provided with keyway for all fixed parts.

Pulley. The pulley is cast iron of ample width, rounded on the face, and is securely fitted to the shaft by means of a key.

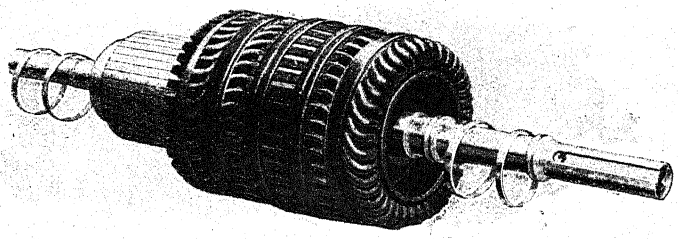


MAGNET.

Armature. Slotted Drum Type, consisting of laminations of high permeability iron stampings, clamped together between cast iron end plates, suitably ventilated. The core slots are designed to give the highest efficiency at all loads without sparking, allowing the direction of rotation being reversed without affecting the proper working. The windings are composed of high conductivity copper wire, cotton covered, braided, firmly embedded in the slots of the core, accurately balanced and securely held by wire bands which are insulated by mica from any portion of the armature.

Commutator. The Commutator, which has a deep wearing surface,

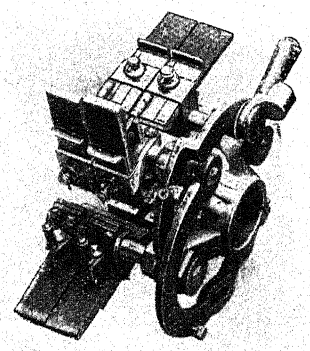
is made up of high conductivity, hard-drawn copper segments, insulated from each other with special selected mica, being held firm by cast steel cones of special design, and insulated with mica rings, and are so proportioned to the current they have to collect as to furnish a good wearing



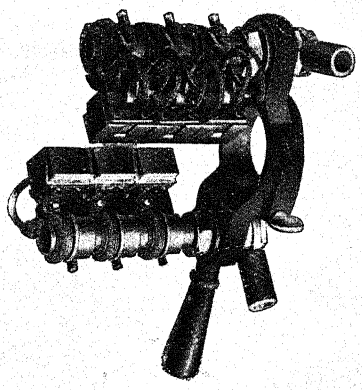
ARMATURE.

surface, and to keep cool when running at the maximum load the machine is built to carry.

Brush Holders. The Brush Holders are of special design, made in brass, and fitted with hold-off catches, and are clamped to brush spindles which in turn are fixed in a movable rocker and insulated from same by



BRUSH HOLDER WITH COPPER GAUZE BRUSHES.



BRUSH ROCKER FITTED WITH CARBON BRUSHES.

means of fibre bushes and washers. Collector rings are provided to take the current from the brush holder spindles.

Types OPF to OPH are provided with collector rings to take the current from the brush holder spindles to terminals, whilst Types OPI and OPJ have in addition flexible high conductivity copper brush leads from collector rings to terminals.

Carbon Brush Holders. These are of special design of the box type—that is, the brushes are free to slide in the brush holder, connection being made to the holder by means of special heavy copper flexible cable fitted with suitable clips. The Brush Holders are clamped to the brush spindles,

and the brush spindles are secured to the rockers and collecting rings in the same manner as our copper gauze Brush Holders.

Brushes. These are copper gauze, or carbon, and are proportioned to the current they have to carry.

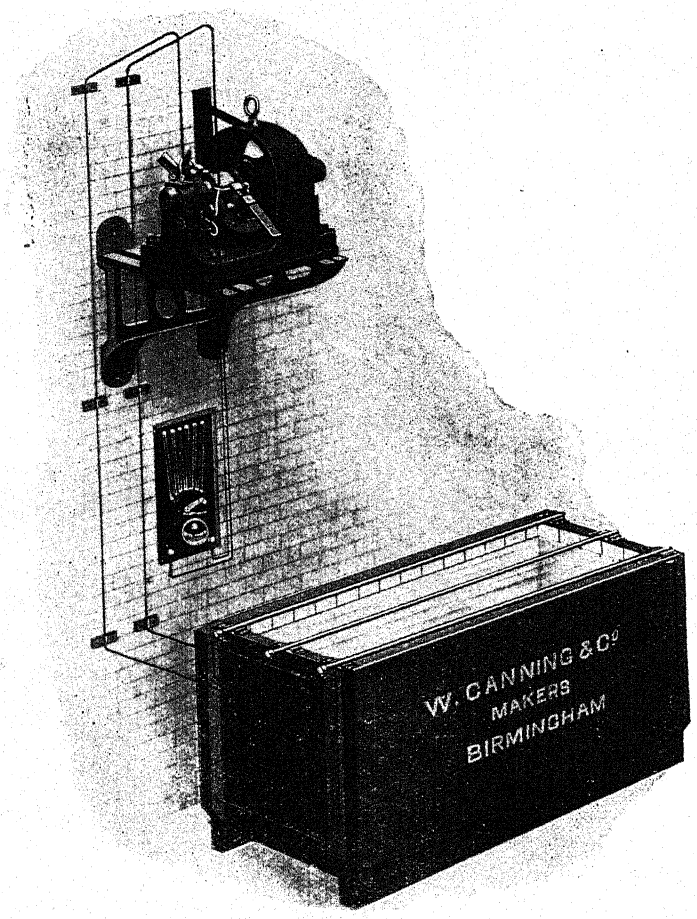


ILLUSTRATION SHOWING POSITION OF DYNAMO ON WALL WHEN FLOOR SPACE IS LIMITED.

Testing. Each dynamo is tested to its full load before leaving the works. The temperature rise does not exceed 70° Fahr. above the surrounding atmosphere after a six hours' run at full load. The dynamo will stand an overload of 25% for one hour without undue heating or sparking, and a greater overload for short periods.

DIRECTIONS FOR FIXING AND WORKING OUR CONTINUOUS CURRENT ELECTRO-PLATING DYNAMOS.

Arrival. On arrival of the Dynamo carefully examine it to find out if in transit it has got damp or injured. The armature (A) should be revolved to see if the shaft (S) works easily. See that no metal or hard substance is lodged between the armature and the magnets.

Position. The Dynamo should be fixed in a convenient and dry position, with as much light as possible. Fix it close to its work, a central position being best. The greatest quantity of current is thus obtained, as the resistance of the cables is brought to a minimum, and the cost of expensive cables is reduced. It is important for the Dynamo to be fixed in a dry place.

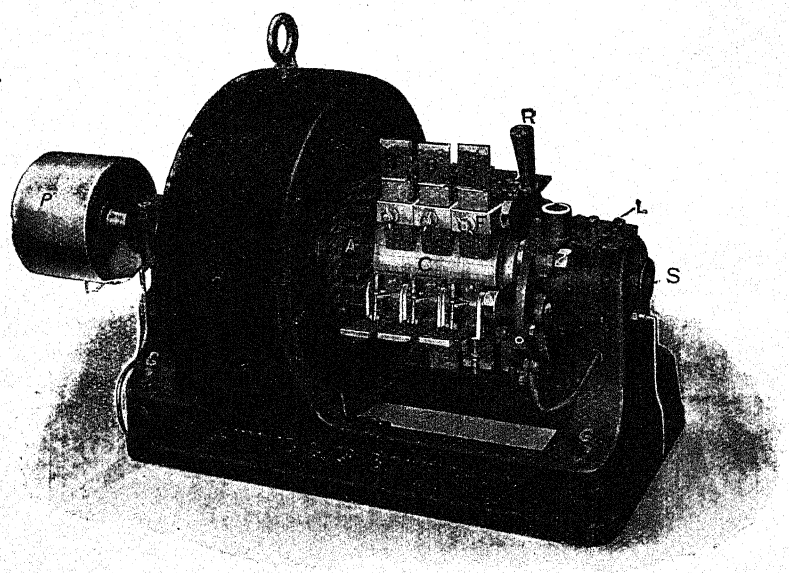


ILLUSTRATION OF OUR PLATING DYNAMO.

Fixing and Foundations. Bolt the machine on a solid and level foundation, as the Dynamo is a piece of high-class, quick-running machinery. If great care is not taken to prevent vibration, the machine will wear out much quicker than it should do. With ordinary care and attention to small details, one of our Dynamos should run for many years. For machines up to 50 ampères, a strong, firmly fixed wooden bench is sufficient foundation to which the machines can be bolted down. Four holes (G) are provided in the bed of the Dynamo for bolts to be inserted, and each hole (G) must be provided with a bolt. For all larger sizes of Dynamo, a brick or concrete foundation should be provided. The Dynamo must rest perfectly level on its foundation before bolting down. Set the Dynamo square with the driving shaft, and note the pulleys are exactly opposite each other and line up true.

Belts. The Driving Belt must be soft and pliable, and not too heavy. It should also be as broad as possible, ½ inch less than Pulley Face. The jointing should be very carefully carried out. If sliding rails are used, an Endless Belt may be employed; otherwise, place the two ends together, and secure by fasteners. Never use a lapped joint, or an unsteady current will result. The underside of the Belt should be the driving side, as a better grip is given to the pulley (P). Avoid vertical and crossed Belts whenever possible. The tension of Belt must not be too great, but sufficient to prevent it from slipping.

Speed. Run the Dynamo at the exact speed stamped on the name-plate; otherwise, if the Speed is too slow, insufficient current will be obtained, and if too fast, the Dynamo will get hot and receive considerable damage.

Direction.—The Dynamo should run clockwise, looking at the Pulley end.

Pulleys (P). Never change the Pulley (P) on the Dynamo. Change the Driving Pulley, if necessary.

Bearings (D). These must be well attended to, and kept so adjusted that they run cool, without knocking or vibration.

Lubricating Ring Oil Bearings. Before starting the Dynamo see that the shaft turns easily in its bearings, also that the lubricating rings run freely; fill the oil wells until the oil reaches higher than the bottom of the lubricating rings; good, clean oil should be used. We supply special oil for lubricating Dynamos. To empty the oil wells, remove the screws provided for the purpose; they should be emptied at least once a month.

Ball Bearings. Dynamos fitted with Ball Bearings are filled with grease before being despatched. This is sufficient to last a considerable time. Periodically fill the Stauffer Boxes with a good, *clean* motor grease and screw down to force same into Bearings.

Commutator (C) and Brushes (B). These two parts of the Dynamo require the most careful, continual, and intelligent attention. Both should be kept scrupulously clean. The tension spring of the Brush-holder (F) should be adjusted to make a light but positive contact with the Brush (B) on the Commutator (C). If the pressure is too hard the Commutator (C) will be cut, and if too light the Brushes will jump off the Commutator when running, causing sparking and damage to the Commutator. The Brushes, which must bed on the Commutator over their whole width and thickness, *must be fixed diametrically opposite each other, and when two or more Brushes are on one spindle they must be set absolutely in line.* Take the Brushes out of the holders (F) occasionally, and thoroughly clean them from all oil, dust, and dirt. Before replacing take off the thin end of the Brush with a file. Never let the Brushes touch the flange of the Commutator. If the Commutator becomes either worn or uneven, it may be polished with fine emery cloth, and filed with a smooth file, great care being taken to wipe off all the particles of dust of any kind. Should the Commutator become so worn that it cannot be filed, the armature (A) should be taken out and the Commutator turned in a lathe. Always remember a file never trues the Commutator; it only smooths it. The Brush-holders (F) should be kept free from all dust, and the metal kept bright. Never remove the brushes from the Commutator when work is on the Dynamo or the speed fully up.

Carbon Brushes should be shaped to the Commutator face by putting a piece of emery cloth on Commutator (with the cutting part facing Brush), then slowly turn the Armature, thus grinding the surface of the Brush to the shape of the Commutator.

Sparking. With careful attention Sparking is avoided with our Dynamos. There is one non-sparking position on the Commutator, and the brushes can be moved about by means of the Rocker (R) till this position is attained. The clamping bolt on the Rocker (R) should then be tightened. This keeps the brushes always in one position. The position of non-sparking in our Dynamos is a little distance from the top of commutator (C) in the direction the machine is running; and the machine should always run away from the top brush.

Always use a shunt regulator to control the voltage of the machine.

Armature (A). If it is necessary to remove the Armature from the Dynamo, great care must be taken not to injure the insulation on the Armature. Never let any dust or particles of metal get between the Armature and the magnet cores. See that the Armature does not foul the Magnets, due to worn bearings.

Connections. Keep all these screwed up tight, thus ensuring efficiency.

Lubricating Commutator. When the Dynamo is in full running order, the Commutator should be lubricated with "Comm-bar," but not much of that.

Sundry Points to be Observed. To keep the current regular your engine or Motor must run at a regular speed.

When no work is on the Dynamo, switch off the current, and raise the brushes from commutator with the insulated handle provided for that purpose.

When there is no work for the Dynamo to do, stop running it altogether.

The secret of making a Dynamo work well is to keep it spotlessly clean.

To ensure the above rules being carried out to the letter, make one man responsible for the proper working of the Dynamo.

Dynamo machines are expensive articles. Do not experiment with them, or give them more work than they can do.

The Dynamo will not give any better results by pressing the brushes hard on the commutator.

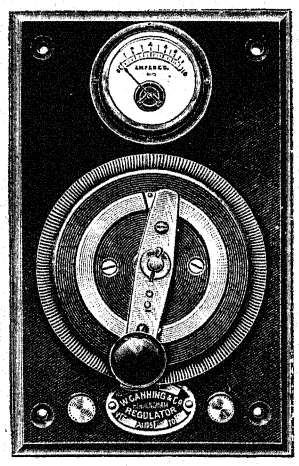
RESISTANCE BOARDS, AMMETERS, AND VOLTMETERS.

Resistance Boards. (*Catalogue, Nos. 7 to 40*). Resistance Boards are necessary to every Plating Plant where a Dynamo is employed, for the efficient regulation of the current. Their use requires to be thoroughly understood, so as to adapt the current for different conditions of work in the Vat. The small boards illustrated on the opposite page are the usual type for small Vats. The base is of slate—a non-conductor of heat and electricity. Wood for many years was employed as the base of these instruments, but this is now obsolete, and as regards England its use is prohibited by Fire Insurance Offices. The two first coils of wire are usually of German Silver of fine gauge and the remainder of Copper

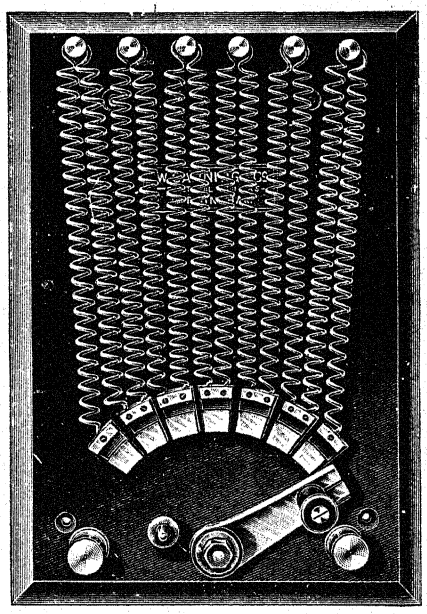
Wire of gradually increasing thickness. The one connection with no wire attached serves to disconnect the current (see illustration, Resistance Board No. 30).

The principle of working these Boards is a simple one. It has been previously mentioned that the resistance to the passage of an electric current in a wire is proportional to its length and inversely proportionate to its diameter and conducting capacity; so it follows, the longer the wires the greater the resistance, and the smaller the wires the greater the resistance also.

It is of great importance to use a suitable Resistance Board in connecting with a Plating Vat. Usually this can only be decided by considering the capacity of the Vat and the nature of the articles to be plated.



RESISTANCE BOARD NO. 7.



RESISTANCE BOARD NO. 30.

For example, assume that a Vat measuring 6 ft. × 3 ft. × 3 ft., with a full load, will take 50 ampères. While loading the Vat it may be found necessary to cut the current down to a low point, and if a larger Resistance Board than is necessary is used, it may be found difficult, or impossible, to cut the current down to that point with this particular Resistance.

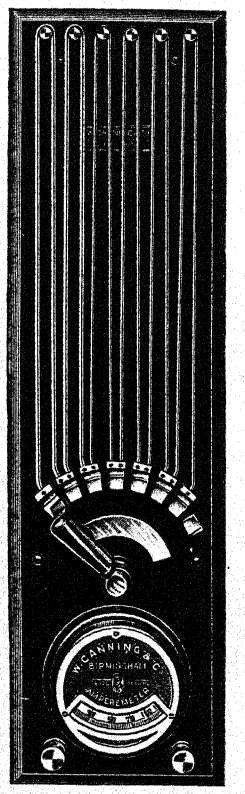
This also refers to jobbing work, where perhaps only one article is to be plated, and a very light current necessary.

It is obvious, therefore, that in such cases the Resistance should allow of a very close adjustment.

On the other hand, the size of the Resistance Board should never be of less carrying capacity than the full current the Vat will take when fully loaded. (See Appendix at end of book.)

Intending purchasers of Resistance Boards, particularly those residing

abroad, when undecided as to which Resistance Board would suit their requirements, should give us full particulars of the size of Vat and solution, and articles to be plated, size and voltage of Dynamo used for the Vat, and leave it to our judgment to send the most suitable Board.



RESISTANCE ON SLATE BASE WITH AMMETER.

TYPE OF RESISTANCE ON IRON FRAME WITH VOLTMETER AND AMMETER FOR CURRENTS OF 250 AMPÈRES AND UPWARDS.

German Silver Wire offers thirteen times cold and eighteen times at 70° Fahr. the resistance to a current that a Copper Wire of same gauge and length does. The two first coils of the Resistance Board, by being of German Silver, offer far more resistance to the current than the other wires of the Board.

So when the handle is moved to the first connection, the current is flowing

through the whole of the wires of the Board. It is thus seen how very largely increased is the length of circuit for the current, and in the case of Nickel-plating the E.M.F., which may be 6 Volts before the resistance is put in, is now usually reduced at this connection to 2 Volts. The handle turned to the next connection takes off the resistance of the first coil and the E.M.F. rises, and so on for the other connections. The enormous importance of these variations in voltage will be seen by reading the figures at the end of this chapter. When the handle is on the first connection (that is, reckoning from the end with the thick copper) there is no resistance employed.

Where several Vats of different or of the same solutions are used, it is necessary to have a Resistance Board in circuit with each Vat.

When large currents are wanted to pass into the Vat such as are used for Electrotyping or Copper depositing, and it is required to strike the work at a different voltage than that for regular working, a board capable of carrying the full capacity is necessary; on the other hand, if the board is only to be used when the Vat is partially loaded, then a board with wires gradually reduced to a carrying capacity of the minimum load is required.

Connecting Resistance Boards. It is usual to place the Board in an accessible position close to the Vat, so that the handle is within easy reach of the operator, and where hot solutions are used, it should be placed out of the way of the steam arising from the Vat.

The cable which is connected to the cathode rod of the Vat should be connected to one of the terminals of the Resistance Board, and a further cable from the other terminal to the lead rod.

The Resistance Board being now fixed, it is desirable and even necessary to have instruments to indicate the variations in the current passing through the Resistance Board. These handy measuring instruments are so inexpensive and withal so important that a Plating Plant is not complete without them. Rule-of-thumb plating should be discarded, as the danger of having a Vat of work stripped or burnt, which is at any time liable to happen, is avoided; therefore it is false economy to dispense with them. The importance of this matter justifies the attention drawn to it.

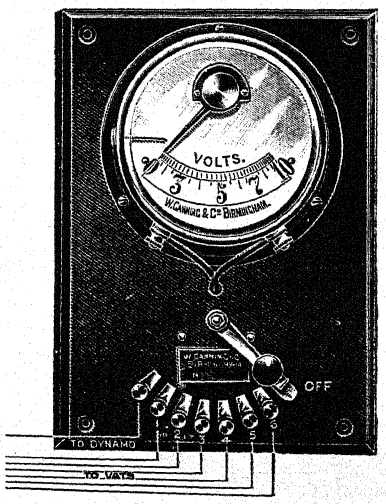


ILLUSTRATION OF VOLTMETER FOR READING THE VOLTAGE ON ANY NUMBER OF VATS.

Voltmeters. (*Catalogue, No.* 48.) First in importance comes the Voltmeter, a register of the Electric Motive Force (E.M.F.), or the Voltage of the Dynamo. The connections of the Voltmeter must be carried out with thin wire, either 24 or 26 B.W.G., and should be covered with

cotton or other insulating material (*Catalogue, No.* 34). Reference to page 16 will show that the two wires must be joined respectively to the positive and negative cables at the terminals of the Vat. This is an important item, as otherwise the Voltmeter will not indicate.

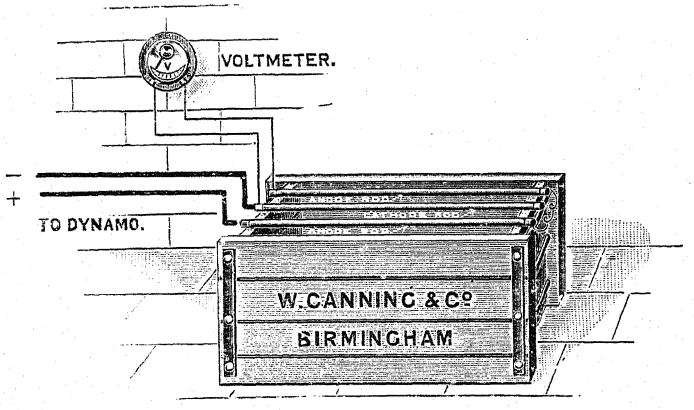


ILLUSTRATION SHOWING VOLTMETER CONNECTED TO VAT.

Where several Vats are used, a Voltmeter should be placed close to the Resistance Board of each, so that the exact position of working can be read, or one Voltmeter can be used for reading the voltage on any number of Vats as shown in the illustration (p. 39). The number of studs must be equal

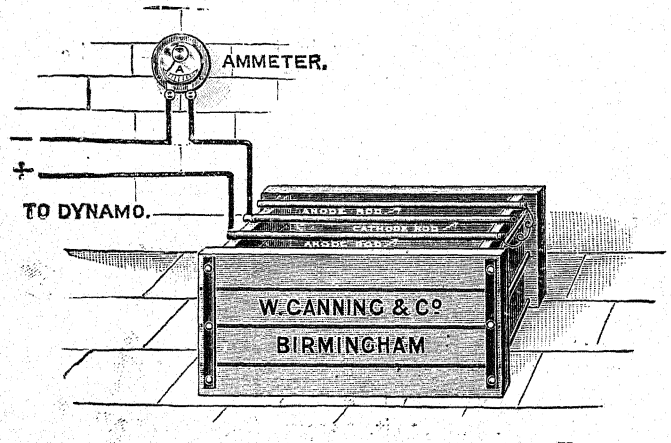


ILLUSTRATION SHOWING AMMETER CONNECTED TO VAT.

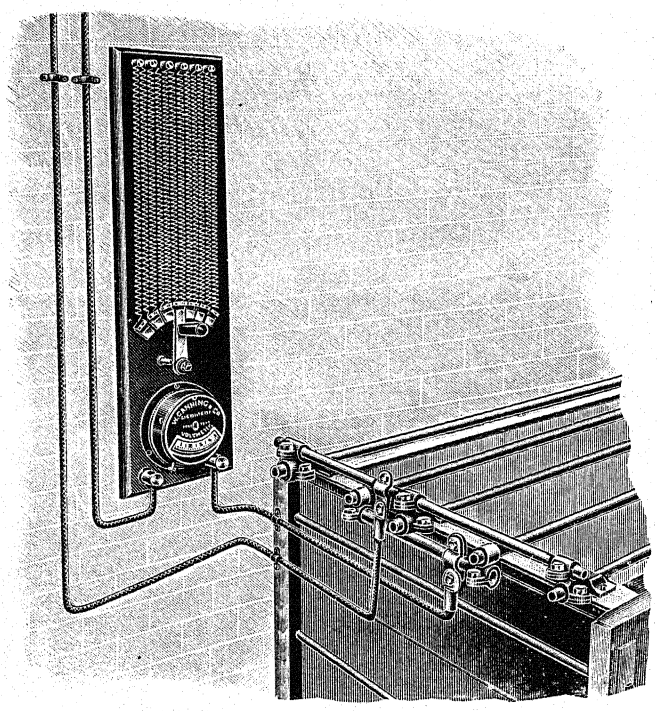
to the number of Vats the operator wants to take the readings of. For this purpose Resistance Boards are made (*Catalogue, Nos.* 29 *to* 40) with the Meter on the same base as the Resistance. They are also made with a Voltmete and Ammeter attached to the same base.

In Plants for Cycle Works with one Nickel and one Copper Vat, a Voltmeter is best placed at the Nickel Vat, as the voltage at the

Copper Vat is not so important. The Voltmeter can also be placed close to the Dynamo, but this arrangement is not so satisfactory for accurate working.

Besides measuring the voltage, or difference of pressure between the Vat terminals tending to drive the current through it, it is quite as important to measure the quantity of current actually passing through at any moment, and this is effected by an instrument called an Ammeter, similar in appearance to the Voltmeter, and is graduated to register the Ampères of Current flowing through it.

These two terms, Volts and Ampères, are frequently confused and misapplied, and perhaps the best way of explaining them is to compare the



CONNECTING VAT.

electric current to the flow of water along a pipe, one end of which starts from the delivery end of a force pump, and the other terminates at the suction end. The pump, as it were, takes the place of the Dynamo or Battery, and on working it a difference of pressure is created which drives a current along the pipe in one direction. The greater the quantity required to be driven along the pipe, the larger must its section be; and to measure the actual flow in gallons, we cut the pipe anywhere and insert a meter to measure there.

In exactly similar way we cut the wire and insert an Ammeter, and the greater this current the larger the sectional area of the wire required. In measuring water, too, the quantity of gallons actually passing is quite a

different thing to the pressure of the water (in pounds per square inch of head of so many feet) in the pipe, though with a given sized pipe the difference of pressure between its ends determines the gallons passing; and with the electric current, the Ampères flowing along a given wire depend on the difference of electrical pressure between its ends (called the Voltage, and which is registered by the Voltmeter).

The Ammeter registers only the amount of current being actually consumed. Thus, if a Dynamo with an output of 100 Ampères is being worked, and only 50 Ampères are being used, the Ammeter only registers the latter amount. An Ammeter should be always connected close to the Dynamo, so that the whole of the current being used can be read. Where several Vats are worked, it is advisable to have one in connection with each Vat, so that it can be seen if enough or too little current is entering the Vat for the work it contains, the Voltmeter being no guide as to this point. For this reason some platers prefer an Ammeter to a Voltmeter in connection with each Vat; but, as before stated, the use of both is to be recommended.

Connecting Vats. In the present system of depositing with heavy currents, the illustration (p. 41) gives a good idea as to the best method of connecting from resistance board to the rods on the Vat. It is necessary that all conductors should be of ample size so as not to offer any resistance to the flow of current.

IMPORTANT NUMERICAL STATISTICS IN ELECTRO-PLATING.

(For other figures see Appendix at end of book.)

THE following data is given from the book on "Dynamo-Electric Machinery" (fourth edition), by Professor Silvanus P. Thompson :—

Quantity deposited per hour.

COPPER.	
386·4 Ampères of current deposit ..	1 lb. per hour.
SILVER.	
112·7 Ampères of current deposit ..	1 lb. per hour
GOLD.	
185·8 Ampères of current deposit ..	1 lb. per hour.
NICKEL.	
412·8 Ampères of current deposit ..	1 lb. per hour.

Voltage or Pressure required for—

Copper (Sulphate)	1½ to 2 Volts.
„ (Cyanide)	2 to 5 „
Silver	1½ to 2 „
Gold	2 to 6 „
Brass	2 to 6 „
Nickel: Strike deposit with 5 volts and diminish to	1½ to 4 „

The figures opposite are only intended as a general approximate guide, as the voltage varies with the nature of the metal being deposited on. For instance, to deposit nickel on brass and copper articles a lower voltage is required, whereas cast iron and tinned iron require a higher voltage; then again articles being plated in bulk in baskets require to be struck with a higher voltage to ensure the articles being deposited all over.

Moreover, some special solutions have a higher current density than others. Our "Nivo" Nickel Solution has a higher current density than an ordinary nickel solution (made from sulphate nickel and ammonia), so that a higher voltage is necessary to drive the current through.

The current densities which can be used with these special Solutions are given on the pages devoted to the different Solutions, such as "Nivo" Nickel Solution, "Zonax" Nickel Solution, Black Nickel, "Zonax" Brass, "Multibrass," "Zonax" Copper and Sulphate Copper Solutions, etc.

After studying these, it will be seen that the Voltage rises in Proportion to the rise in current density and *vice versa*.

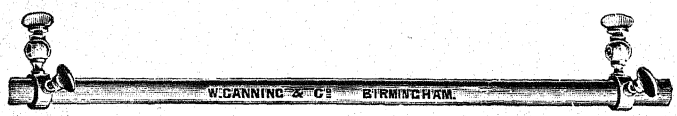
Quantity of Current or Density for Proper Deposit.

	Amperes per sq. ft.
Copper Typing, Good Solid Deposit	10 to 20
„ (Cyanide)	2½ to 4
Silver	2 to 4
Gold	¾ to 1½
"Zonax" Brass Solution	2½ to 4
"Multibrass" (Heavy Brass Plating Solution) ..	10 to 25
"Ajax" Zinc	8 to 16
"Zonax" Nickel	2 to 3
"Nivo" Nickel	6 to 7
"Zonax" Tin	3 to 5

If Solutions are agitated the current density can be doubled, or in some instances trebled. (See also Appendix at end of book.)

NICKEL-PLATING.

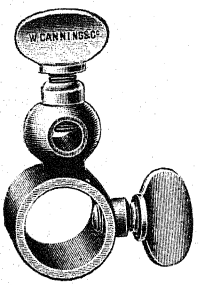
A VAT as described on page 17 is used, and care must be taken to ensure it being lined with pure chemical lead and burnt joints, and match-boarded. These are the only kind of Vats we recommend for Nickel Solution. Place on the floor some timbers the length of the Vat, thickness according to its depth; a convenient height is 2 feet 6 inches to 3 feet



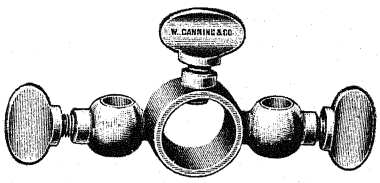
6 inches from floor to top of Vat. This is to keep the bottom of the Vat from rotting. The Vat being placed in position and the Solution put in as described later, place Brass Rods across the Vats, with Insulators as illustrated in the Plating Shop (page 16), and on these are hung

the Anodes and articles to be plated. If three Rods are used, the two Rods outside are used for the Anodes and the centre one for the articles to be plated; if a wide Vat is used and five Rods are placed on the Vat, the two outside and the centre one carry the Anodes and the other two the articles, and they are connected as shown in diagram, page 16.

Any number of Rods can be used on a Vat if of sufficient width, so



CONNECTION A.



CONNECTION B.

long as the articles to be plated have an Anode on each side. On the Rods are placed Connections for connecting the cable; and if Connection A is used, the Rods should rest at each end upon one of the Rod Insulators described on page 18. The Insulators should be screwed on to the Vat, care being taken that the screws do not pierce the lead lining.

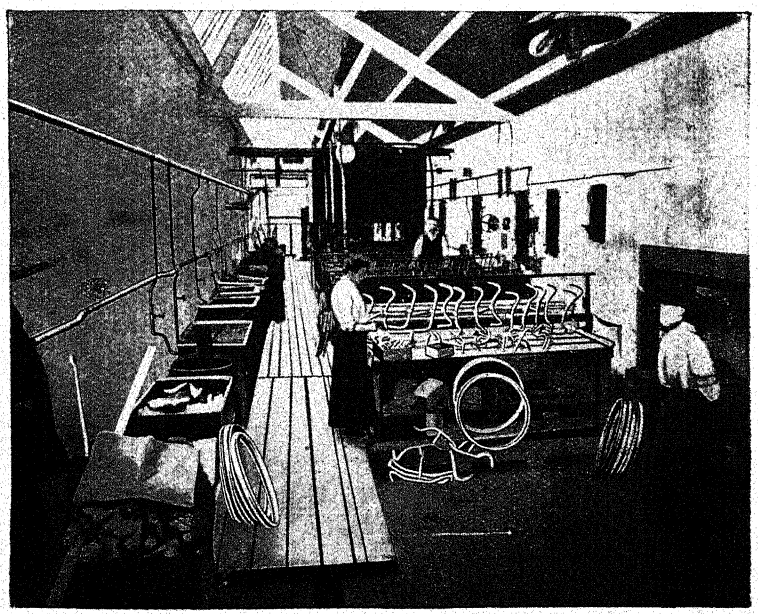
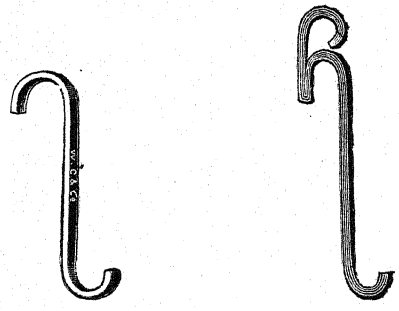


ILLUSTRATION OF CYCLE MAKER'S PLATING SHOP.

If Connections B (*See Catalogue, No.* 243) are used, they are screwed on the top of the Vat and hold the Rods in their right position.

The Rods and Connections must be kept perfectly clean, and all Connections well screwed up. The Rods can be cleaned by dipping them in a solution of Cyanide Potassium and brushing with sand, then swilled and dried with a dry rag. The Rods on which the Anodes hang may be kept much cleaner by placing over them some thin pieces of timber made in the shape of the letter V inverted. We strongly advise this method.

The Nickel Anodes are now placed in the Vat on the Rods as before described, and we recommend that they should be hung on the Rods with nickel hooks as illustrated thus (either pattern will do) :



The hook with the loop on top is to facilitate the removal of the Anodes.

The Nickel Anodes should be of pure Cast Nickel, free from copper. The Anodes bearing our name may be relied upon as being perfectly pure. Rolled Nickel Anodes may be sometimes used in connection with the cast. This depends upon the nature of the solution used.

Some men of experience assert that the bath keeps neutral longer by adopting this method. Anodes which are cast in iron chills should be avoided.

The quantity of Nickel Anodes used in the bath should be at least equal in surface to the articles being plated; and when they become spongy they should be replaced, and the old nickel, which is of some value, returned.

Nickel Solution. When a Nickel Solution is required for all-round work—when the user has had little experience in Nickel-plating, and when a good deposit of silvery whiteness is required —then "Zonax" Nickel Salts are invaluable.

It is the most easily worked Nickel Solution obtainable.

To make a new solution take ¾ to 1 lb. of "Zonax" Nickel Salts and dissolve in 1 gallon of clean boiling water. Place the Salts in a wooden tub (*See Catalogue, No.* 221), earthenware vessel (*Catalogue, No.* 313), or enamelled iron vessel

(*Catalogue, No.* 211), add the boiling water and stir till all is dissolved. *On no account dissolve the salt in a galvanised iron vessel, or the solution will be spoilt.* When the solution is cold it should register from 6 to 7 on our Nickelometer, and should be kept at this strength by the addition, from time to time, of the "Zonax" Nickel Salt. *When making up a new Vat of Solution fill the Vat half full with cold water. As the Salts are dissolved in the boiling water, add them to the cold water in the Vat; this will prevent the Salts crystallising out on the inside of the Vat.*

The Solution made as here described requires no addition whatever if the water is good. If the water is *very hard*, a little ammonia, either liquid or carbonate, added will improve it, *but the greatest care must be used in not adding too much.* About 1 pint liquid, or 1 lb. carbonate ammonia to every 100 gallons is sufficient. The voltage across the terminals of the Vat should be 1½ to 2½ volts. If the solution is agitated 3 to 4 volts can be used with safety.

If the solution becomes too Alkaline when being worked, add some Canning's Single Nickel Salts (Sulphate Nickel) till the solution becomes normal. If the solution becomes Acid when being worked, add some Canning's Nickel Carbonate till the solution becomes normal.

For keeping up the strength of nickel baths in constant use, or if a Nickel Solution requires replenishing in the ordinary way, a bag of "Zonax" Nickel Salts is hung on a rod in a convenient position and allowed to dissolve. When dissolved, the solution should be stirred well overnight and allowed to settle ready for work next morning.

We recommend to all who use nickel baths made from our "Zonax" Nickel Salts to keep some of the Salts on hand; it saves time and labour, and is always ready for use.

The Cleaning Vat. This is placed as described on page 19. The importance of this Vat in a Plating Shop cannot be over-estimated.

To make the Solution: ½ lb. Canning's Lyco and 1 gallon of water. Fill the Vat with water to within 4 inches of the top, then put in ½ lb. Lyco to each gallon of water, stir occasionally till all is dissolved; add some more Lyco from time to time to keep up its strength.

This Vat should be cleaned out every 2 to 3 months, as the dirt and grease which is absorbed settles to the bottom. It can be done in the following manner: Allow the Solution to settle, then syphon off the clear Solution into some receptacle, clear out the bottoms, put back the clear liquid, and add fresh Lyco and water to fill up the Vat. A completely new Solution should be made every 6 months at least.

Potash is sometimes used in the place of Lyco, but we recommend the latter for its uniform strength and exceptional qualities for cleaning and absorption of grease, besides being very much cheaper.

For holding acids for pickling or cleaning small articles preparatory to plating, a Barrel as illustrated is recommended.

When articles are pickled or cleaned in baskets no friction between the articles takes place; by using a Barrel the articles rub against each other, which helps the process of pickling or cleaning.

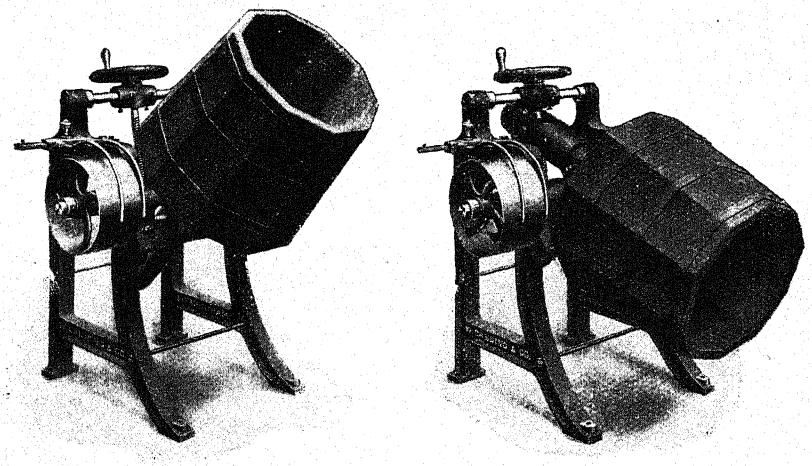
The Barrel is made of wood, mounted on a cast-iron frame, which in turn is mounted on standards, with fast and loose pulley. It has an arrangement by which the barrel can be tilted to empty.

The wooden barrel can be replaced at a very low cost when worn out, which is one of our objects in making this pattern Barrel.

For particulars of Electrolytic Cleaning, see page 88.

Scouring Trough and Scouring. This is described on page 19. Care should be taken that the water supply is ample and the outlet from the overflow pipe is properly let into a drain; it is absolutely necessary that a constant supply of clean and clear water should be used.

The Hot Water Tank. This is described on page 20, and care must be taken that this is often emptied, and only *clean* water used.



Cleaning and Pickling Barrels, No. 924.

Sawdust Pan and Sawdust. This should be kept well heated, and a good supply of Sawdust always at hand, free from all resinous matter. Boxwood Sawdust only should be used. When the Sawdust gets dirty it should be changed.

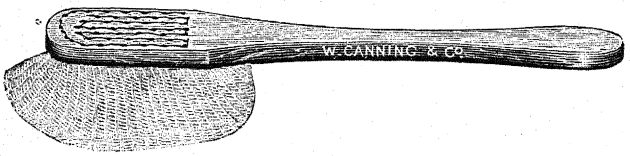
Small articles can be dried out in Boxwood Sawdust revolving in a wooden Barrel. See also page 87.

Cyanide of Potassium Dip. This is made by dissolving 6 oz. Cyanide of Potassium in one gallon water, and we recommend it should be kept in an earthenware vessel (*Catalogue, No.* 313) or in a wooden tub (*Catalogue, No.* 221), according to the size of the article to be dipped.

Acid Dips. These should be put into earthenware vessels, as described for Cyanide of Potassium Dip, and when not in use kept covered up.

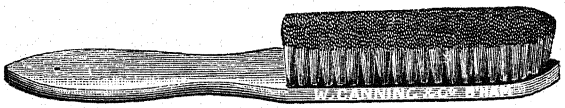
Plating Process. Having described the various Vats, etc., used for Nickel-plating, we will now describe the process used for carrying out the work. First we will describe how parts of cycles are Nickel-plated. The articles, as brought from the Polishing Shop, are attached to some soft

copper wire, by twisting the wire round a convenient part of the article, leaving sufficient length of wire to allow of the article to be submerged in the solution and to twist firmly round the Cathode Rod on Vat. When this has been done, they are placed in the Cleaning Vat for about 15 minutes, and if any dirt or grease still adheres they must be brushed with a Cotton Cleaning Brush (*See Catalogue, No.* 622), as illustrated, then swilled in the



COTTON CLEANING BRUSH.

Cleaning Solution. When removed from the Cleaning Vat they are swilled in the Scouring Trough and scoured by brushing all over with a Scouring Brush (*See Catalogue, No.* 598), illustrated, and Scouring Powder, then swilled in the water. Care must be taken that all the small holes are cleaned out well, and no dirt or powder is left in any holes or crevices. Brushes for this purpose (*See Catalogue, No.* 601), illustrated, can be used ; but if not at hand, a stick can be used to rimer out the holes. A perfectly chemically clean surface must be obtained ; care must also be taken that



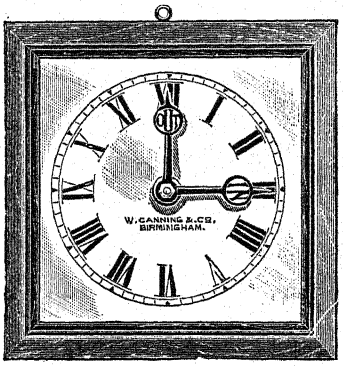
SCOURING BRUSH.

the articles are not touched with the hands after they are scoured, or stripping will result. When an article is thoroughly scoured, water will adhere to it on every part. After the articles are scoured, keep them covered with clean water until they are placed in the Plating Vat. The current having previously been switched on, the articles are left in the Solution from 1 to 3 hours, according to the thickness of deposit required. We recommend for cycle work 2 or 3 hours. If the Solution is agitated the articles will only require to be in Solution half the time required in a

SMALL CLEANING BRUSH.

stationary Solution, providing the current density is increased, see page 43. Strike the work with about 3 volts, and after a few minutes reduce the current to $1\frac{1}{2}$ to $2\frac{1}{2}$ volts at the terminals of the Vat. If Solution is agitated 3 to 4 volts can be used. Whilst the deposit is going on, the Rods should occasionally be moved, either lifted or tapped, to release the gas which forms on the articles. If the Solution is agitated or a mechanical

arrangement is used as described on page 58, the tapping of the Rods is not required. The articles are now removed from the Vat, swilled well in the Hot Water Tank, then rubbed dry in the sawdust. The wire is taken off and should be carefully straightened, ready for further use. If the work is properly carried out, and our Pure Nickel Anodes and Zonax Nickel Salts are used, a rich silvery deposit is the result.



A handy means for the operator to know when the article is to be removed from the Vat is to fix by the Resistance Board over the Vat a clock face as illustrated.

When the work is placed in the Vat set the hand at the time it has to be taken out.

Nickel plating is done direct on to iron, but for high-class work and certain special goods it is best to copper the article first.

Copper-plating Parts of Cycles. If the parts of cycles are to be Copper-plated, they should have a good thick deposit. After the work is wired, cleaned, and scoured, as described in Nickel-plating, they are put into the Copper Vat. If a Cold Solution is used, a Wooden Vat lined with lead (see page 17) is used, and the articles should be left in 20 to 30 minutes, when they should be removed, well swilled in cold water,

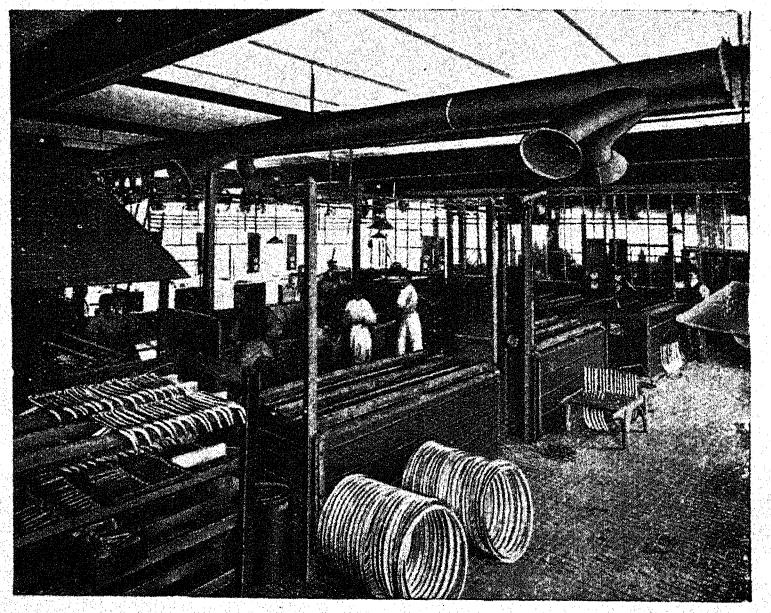


ILLUSTRATION OF CYCLE MAKER'S PLATING SHOP.

then in the hot water, and dried in the sawdust. They are then taken to the Finishing Room, mopped up on the Polishing Mops—the small parts, such as nuts, pins, etc., can be well brushed in the Scouring Trough, instead of being mopped—after which they are cleaned, wired, and scoured, and put in the Nickel Vat to be Nickel-plated.

If Hot Copper Solution is used, an Iron Vat (*See Catalogue, No.* 212) must be employed having a wooden frame (*See Catalogue, No.* 213), and heated as described on page 21.

Hot Copper Solution for plating cycle work should be used at about 120° Fahr. If the articles are left in the Solution 15 to 20 minutes, they require scouring before being Nickel-plated. Better to have them mopped, as described in Plating with a *Cold* Copper Solution. If, on the other hand, only a flush of copper is required, they are only left in the Hot Solution a few seconds; when removed, well swilled in cold water and placed in the Nickel Bath immediately. We recommend a good thick deposit, as described above.

To make the Solution, refer to page 93.

Copper Anodes as large as possible should be used, and must be at least as large in surface as the articles in the bath. For Copper Anodes see *Catalogue, No.* 135.

Notes to be observed on Copper-plating. If the deposit is a dark red colour and is not firm, but spongy, it is an indication that the current is too strong, and resistance must be put on. Articles Copper-plated in a hot solution which are to be Nickel-plated must not be exposed to the air, but should be immediately, when taken from the Copper Bath, well swilled in cold water, scoured, and put in the Nickel Vat, the latter having the current on.

The best current to be used for Copper-plating is 2 to 5 Volts across the terminals of the Vat.

For further particulars on Copper-plating, see pages 91 to 96.

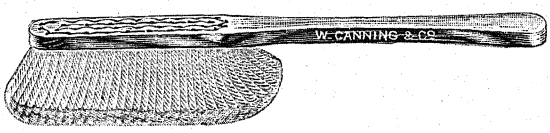
Iron, Steel, Cast or Malleable Iron Articles intended to have a high finish must be well polished before plating, and all scratches from the emery bob must be removed (*See article on Polishing*). The article is then wired and put in the Cleaning Vat, as before described; then scoured well with Scouring Powder for Iron, until all grease and dirt is removed; it is then placed in the Nickel Bath from 1 to 2 hours, according to the thickness of deposit required. Voltage—strike the work with $3\frac{1}{2}$ volts, and after a few minutes reduce the current to $1\frac{1}{2}$ to $2\frac{1}{2}$ volts at the terminals of the Vat.

Brass, Copper, and German Silver Articles are wired, then put in the Cleaning Vat for about 5 minutes, taken out, well swilled in cold water, then swilled in the Cyanide of Potassium Dip (as described on page 47) to remove any stains from the Cleaning Vat, then well swilled in cold water. Scour the articles well with soft scouring brushes and powder (*See Catalogue, No.* 598): see page 89 on Electrolytic Cleaning. After scouring they are well swilled and put in the Nickel Vat and left from 1 to 2 hours, according to thickness of deposit required. Voltage at the terminals of the Vat, $1\frac{1}{2}$ to 4 volts, according to solution.

For Cast Iron Articles, such as Stoves, Lamp Stands, etc., which are not polished and require a dead White Nickel Colour after plating, care must be taken to ensure the removal of all scale, either by pickling the article in acid or scratch-brushing (as described in chapter on Brass and Copper-plating, page 91).

The articles are wired, scoured, then plated and dried out in the usual way.

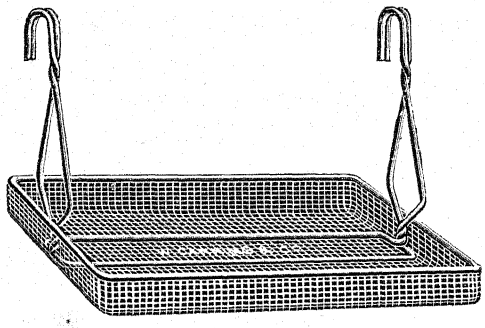
Tin Articles, or Tinned Iron Articles, such as Waiters, Dish Covers, etc. Clean in a Solution of Caustic Potash, ½ lb. dissolved in 1 gallon of water. Put in this Solution for about 5 minutes, brush over with a cotton brush (*Catalogue, No.* 622): see illustration. They should then



COTTON CLEANING BRUSH.

be swilled and scoured with powdered Lime, finally swilled in clean water, and put in the Nickel Bath from ½ to 1 hour, according to the thickness of the deposit required. It is advisable, if a large quantity of this work is done, to keep a Nickel Vat specially for this work.

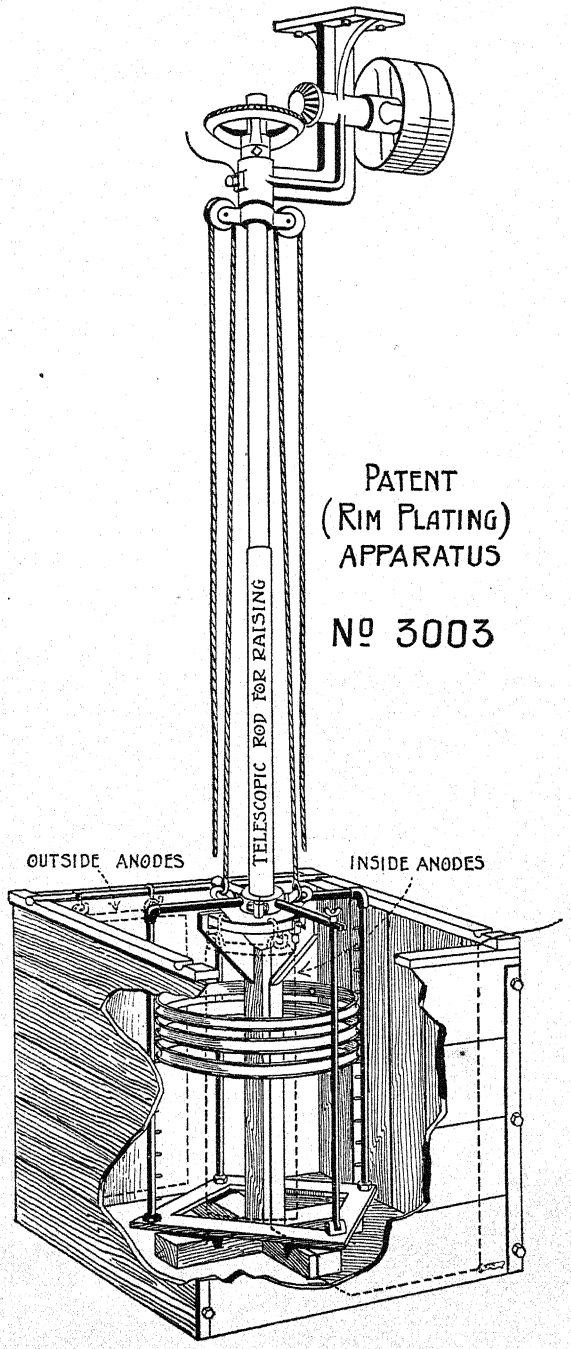
Nickel-plating Small Articles. If quantities of small articles are required to be Nickel-plated, they are sometimes placed in Copper, Brass, or Aluminium Wire Baskets (*See Catalogue, No.* 323), as illustrated. Care



WIRE BASKET.

must be used to turn them over frequently, or the parts which touch will be black and have no deposit. Perforated metal sheets are often employed for such articles as screws, cycle spokes, etc. They are cleaned and scoured, as before described (see pages 64 to 87).

Patent Rim-Plating Apparatus. To plate rims in quantities, we are manufacturing a patent apparatus consisting of a cage to hold 12 or more rims; a standard is fixed in the Vat fitted with Anodes, round which the rims revolve, thus ensuring a good deposit on the inside of the rims, or to that part which is exposed to view when the tyres are fitted. The Vat should be preferably 3 feet deep, with the four sides well lined with Anodes



PATENT RIM-PLATING APPARATUS.

The Cage being revolved in the solution, a greater quantity of current may be used than in a stationary Vat, which results in a better and more even deposit in about half the time required in the ordinary way. The cage may be readily lifted from and lowered into the Vat by an overhead arrangement of pulleys, ropes, telescopic tubes. Each rim requires a current of about 10 ampères.

When the apparatus is not in use, it can be raised from the Vat, and the Vat used for ordinary work.

By using this patented apparatus a great saving is effected in the number of Vats required, the rims being plated in one-half the time, and an even deposit of Nickel is obtained all over the inside of rims where the friction takes place through the application of the brake.

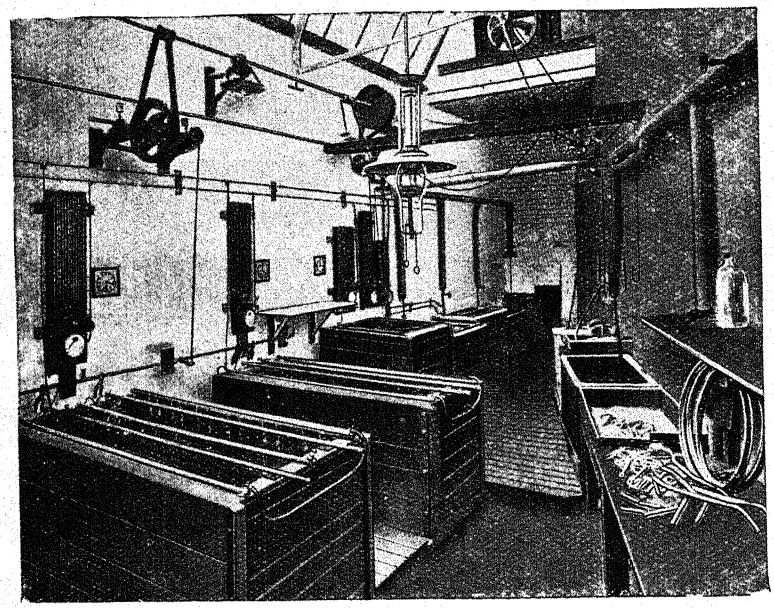


ILLUSTRATION OF COVENTRY PLATING SHOP.

NOTES ON NICKEL-PLATING.

TAKE the Anodes out once a week and scour them well to remove all Oxides. When the Anodes are worn away, send the old Nickel back; it is of some value.

The Vats should be cleaned out about every six months. Syphon off the Clear Solution, get out the sediment from the Vat, replace the Clear Solution, and make up by adding new.

Never put Nickel Solution in a Galvanised Iron Tank.

Stir the Solution every Saturday with a stick after leaving off work; it will then settle down ready for use on Monday morning.

Skim the Solution every morning before commencing, if any dust or foreign matter of any kind is on the surface.

Cover the Vats over with Calico when not in use.

Always remember that cleanliness is a most important factor in successful plating.

Dust on the surface of the Solution often gives the articles a pitted appearance when Nickel-plated.

Always have the current passing through the bath whilst same is being filled; the article requires striking immediately it is placed in the Solution.

Always remember, a large article or a number of articles require a thicker wire to conduct the current from the rod than a small one.

Keep the temperature of the Plating Room at 60° Fahr. in the winter, and never on any account let your Solution freeze.

If the temperature of the room falls to nearly freezing-point, the Nickel Salts will re-crystallise, and consequently the Solution gets poor. These must be re-dissolved.

If Vat is full and more Nickel Salts have to be added, take some of the Solution out of the Vat, boil in an enamelled vessel, and add the fresh Nickel Salts.

When making up a Vat of Nickel Solution, never allow Solution to be less than 3 inches from the top of Vat.

Never put anything into the Solution if it is working well, or trouble will ensue.

Liquid Ammonia in a Nickel Solution is a plater's greatest enemy. If you do not know how to use it, leave it alone.

When a Nickel Solution fails to work satisfactorily, take a small portion from the Vat, and add required chemicals in small quantities until a proper result is obtained. Calculate quantity of solution in Vat, and add chemicals in same proportion as used in smaller or testing quantity.

NICKEL BATH TROUBLES.

Stripping. The most frequent cause of stripping is a want of care on the part of the cleaner or scourer. It may occur also if the articles are not "struck" quickly enough, or if the work to be plated has been nickelled before and some of the former deposit has been left on.

Burning. This is due to the use of too high a current density. The burning occurs most pronounced on those portions of the work where the current density is highest, namely the lowest parts, and any protruding portions. The burnt portions are dark, and even may be black in colour, and are difficult to finish; sometimes stripping will occur on such parts.

"Pitting" (or Pin Holes). This is due to bubbles of gas liberated at the cathode, being allowed to remain resting on the surface of the work. Where a bubble rests, there but little deposit—or none at all—is formed. In order to avoid this defect take care:—

(1) That your solution is just acid or neutral. It should not be too acid and it should not be alkaline, except for very special purposes.

(2) That your anode surface is good. If your anodes are old ones, brush them with pumice to obtain a good clean surface. "Good anodes and plenty of them" is an economical rule for the plating shop.

(3) That hooks and connections are clean, also that your solution has no dust floating on it or in it. The Vat should be cleaned out and the solution filtered at frequent intervals.

(4) That your solution has plenty of metal in it. Add single Nickel Salts only for replenishing your bath.

Flakey Deposit. If the articles, when plated, have a deposit which can be scraped off in scales when the thumb is rubbed along, the trouble is, most probably, that the solution is too alkaline.

Alkalinity is also detected by the deposit having a dark or yellowish tinge. Add Sulphuric Acid in small quantities and with very great care, stir up well and allow to settle. Replenish with single Nickel Salts.

There are other troubles which may occur, but we have dealt with those most commonly occurring.

Spokes. If plating is required at one end only, wrap some copper wire tightly round a bundle of Spokes at the end to be left unplated—viz., the screwed end ; the heads will then spread out and allow sufficient space for Solution to circulate all round them and give an efficient deposit. Hang in Solution to depth of plated surface required.

If plated all over, use a copper or brass tray, perforated with holes sufficiently large to admit the Spoke without allowing the heads to pass.

Small articles, such as Buckles, Rings, and any articles which cannot be hung on wire, can be suspended by a suitable bracket (see pages 64 to 87).

Lead and Pewter articles should have a good coat of Copper deposited on them before they are Nickel-plated.

Nickel-plating Old Articles, such as Tin Dish Covers, Tin Waiters, Milk Cans, etc. Each should be well polished on a suitable mop with Lustre Polish, then given a good coat of Copper in the Copper Bath, mop the article again, clean in the usual way, and place in the Nickel Bath.

To ascertain if the Cleaning Vat requires addition of "Lyco," dip in the fingers, and if same appear slimy it is all right ; if the touch is dry add some "Lyco" at once. A 50-gallon Vat requires about 7 lbs. per week, added if in full work.

The Copper Wire which has been used is of some value ; when a good quantity has accumulated, send it back to us for an allowance.

If the articles in a Nickel Bath hanging at the end of the rods get burnt, and the articles in the centre are all right, hang a piece of Brass or Copper Rod at the extreme end.

To ascertain the capacity of a Vat multiply the length by the breadth and the product by the depth ; this will give the cubic measurement. Multiply the cubic feet by $6\frac{1}{4}$, and the result will be capacity in gallons.

Example :—

6 ft. × 2 ft. = 12 ft. × 3 ft. = 36 cubic ft.
36 cubic ft. × 6¼ = 225 gallons.

Rubber Gloves are useful for preventing action of chemicals upon the hands (*See Catalogue, No.* 326).

If there is no current going into the Vat—this is easily detected by the meter, or by the absence of gas bubbles rising slowly but surely round the article being plated—and the Dynamo is working all right, it shows that some connection is bad or requires cleaning ; trace it right from the Dynamo to the Vat.

Always remove the Rods from the Vat when cleaning them ; do not rub them with emery cloth over the Solution.

Re-plating. It is always advisable to remove old nickel from iron or steel by polishing, or a much quicker and simpler method is by using

CANNING'S "LAYBERE" NICKEL STRIPPING SOLUTION.

Polishing off old nickel is a lengthy and often difficult, if not impossible, task when angles and crevices have to be polished.

"**Laybere**" strips a coat of nickel in a few minutes which may have taken two or three hours to deposit, and strips every particle from crevices and parts where polishing would mean an arduous task.

Neither does it damage the article as in other processes.

It is simply invaluable in repair shops.

"**Laybere**" also strips nickel off any metal.

Instructions for Working.

The Solution must be contained in a Lead Lined Vat. The work to be stripped is used as the Anode, and the Cathodes must be of Sheet Lead or of Carbon.

The Lead Sheets must be removed from the Solution from time to time, swilled and brushed well with Powdered Pumice, swilled again, and after being allowed to drain, replaced in the Solution.

A Resistance Board, with a Voltmeter fitted reading to 6, should be used to properly regulate the current.

The Solution must be kept at a density of 50° to 53° Beaume. When it falls below 50° Beaume, pure Sulphuric Acid must be added and stirred in until the proper density has been obtained. Care must be taken to introduce as little water as possible into the Solution, and in using the bath not to splash the Solution on clothes or skin.

Current. The correct Voltage to employ is 3½ to 6 Volts across the terminals of the Vat.

Working. Articles to be stripped must first be freed from all grease and dirt by placing in a Solution composed of ½ lb. Canning's "Lyco" to 1 gallon of water, used almost boiling if necessary, scoured as for plating. They must then be swilled in clean running water, and allowed to drain well before placing in the bath. As already mentioned, do not introduce any more water into Stripping Solution than can be helped.

The articles must be suspended from the Anode Rods (Lead Plates or Carbons are the Cathodes) by thick *iron* wire, and allowed to remain until all the Nickel has been removed. *Articles should not be placed in the Stripping Solution until the current is switched on*, and not left in longer than is necessary to completely remove the Nickel coating.

If articles fall into the Solution they must be at once removed.

When the work is removed from the Stripping Solution, it should pass through a "Lyco" Solution ($\frac{1}{4}$ lb. to 1 gallon of water), thoroughly swilled in clean running water, then, if desired, dry in hot boxwood sawdust.

The size of the Vat is determined, of course, by the quantity of work to be stripped.

Another Method of Stripping Nickel from Brass, Copper, Iron, and Steel Articles. A mixture of 2 parts Sulphuric Acid and 1 part of Nitric Acid, added to 1 part of water, and mixed together in an earthenware pan. Add the acid to the water and not *vice versa*. If the articles are small, they are put in an earthenware dipping basket. Large articles are wired, and allowed to remain in the Acid Solution till all the Nickel is dissolved, which usually takes from 10 to 60 minutes. The acid also dissolves the metal, and care must be used in this process not to injure the article being stripped. When all the Nickel is removed, swill well in cold water, dry in sawdust, and the article is ready to be polished.

AGITATION OR CIRCULATION OF SOLUTIONS.

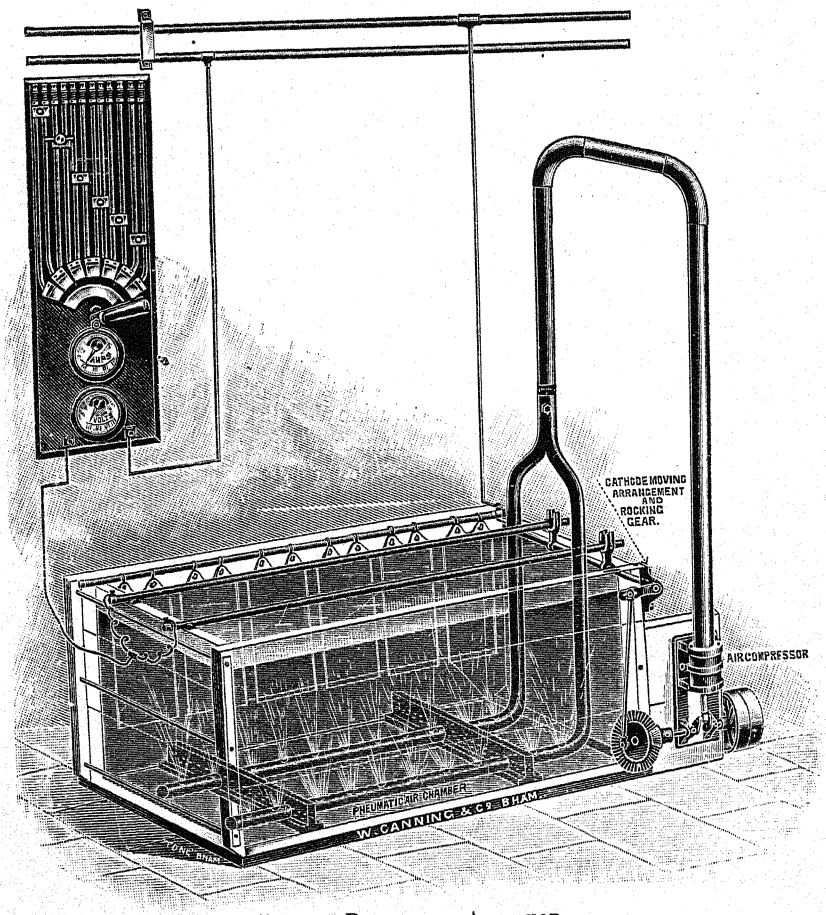
THE circulation or agitation of Solutions for electro-deposition—more especially for copper-plating or electrotyping—has commanded the attention of many experts. The success attending the use of our Patent Agitator for this purpose has been very marked, and by adopting this system to nickel-plating, we have achieved further success.

By the system of agitation, the time taken by the operation of nickel-plating has been reduced by one-half—that is to say, best work which in a stationary Solution would occupy the Vat from 3 to 4 hours may now be coated equally well in from $1\frac{1}{2}$ to 2 hours.

It follows, therefore, that by the adoption of this system a plant so fitted is able to produce as much work in a given time as one of twice the size on the ordinary stationary Solution system.

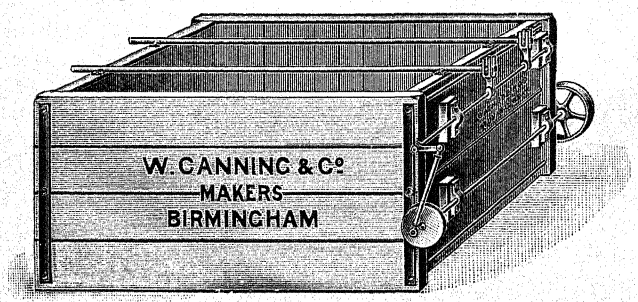
The system of circulating the electrolyte brings a continual supply of Solution of full metallic content in contact with the electrode. There is therefore less resistance to the current, which may be used in greater quantities without danger of burning or oxidising. By using an increased amount of current, a greater deposit is made in a given time; thus, by actual trials we find that for a given quantity of work in a stationary solution, the maximum amount of current which could be safely used was 35 ampères at E.M.F. of 2 volts, giving C.D. of 70 watts. The time occupied was 3 hours. The same Vat was then used with an agitator, the same Solution and Anodes, and an exactly similar load put into the Vat; a current of 65 ampères at E.M.F. of 3 volts = to C.D. 195 watts was used with every success. In 1 hour a deposit equal to the previous load was obtained. The work was smoother and brighter.

Excellent results have been obtained from plants installed on this method, notably in the Cycle, Harness Furniture, and Cast-Iron Trades:



PATENT PNEUMATIC AGITATOR.

Large plants which have been working for a considerable time are giving the utmost satisfaction. In the Printing Trade, plants for the deposition of copper are working very satisfactorily.



MECHANICAL ARRANGEMENT FOR MOVING CATHODE RODS.

CANNING'S "NIVO" NICKEL SALTS, FOR MAKING A RICH RAPID DEPOSITING NICKEL SOLUTION.

THE deposit obtained from this Solution is soft, bright, close in the grain, and white in colour. An equally thick deposit can be procured in half the time occupied in a solution made with Sulphate Nickel and Ammonia or Double Nickel Salts.

The "Nivo" Nickel Solution is specially suitable for plating Cycles, Cycle Accessories, Cast-iron Stove and Grate Work, Sad Irons and other Cast-iron articles of any description. It is also very suitable for Brass articles where a very thick deposit is required—Motor Car parts, Skates, Harness Furniture, such as Bits, Stirrups and similar articles.

We claim for Canning's "Nivo" Nickel Solution that :—

1. An equally heavy deposit can be procured in half the time occupied in the ordinary solution of Double Nickel Salts.
2. A brighter deposit, requiring less finishing.
3. No mysterious conditions are involved in its use.
4. The "Nivo" Nickel Solution can be used with equally good results direct on steel, wrought or cast-iron, brass, etc.
5. Any Anode of pure nickel of 99% purity can be used. We have supplied thousands of gallons of this solution to important firms, and repeat orders are constantly being received.

Canning's "Nivo" Nickel Solution can be accepted as a profitable replacement of the ordinary solution, and is supported by the highest technical skill combined with long practical experience. No agitation is required with "Nivo" Solution. Articles can be plated, and any parties interested can see their own articles actually done in our own showrooms at Great Hampton Street, Birmingham, or St. John's Square, Clerkenwell, London, or may send some articles which will be plated and immediately returned, with full particulars given.

Instructions for making and working a Heavy Rapid Depositing Nickel Solution from Canning's "Nivo" Nickel Salts.

The Vat—Its Condition. The Vat must be absolutely clean. If an old Vat is used which has contained Nickel Solution, all salts which have crystallized to the wood must be scraped off and removed. Care must also be taken that no old salts or sludge has got behind the match-boarding. Wash the Vat once or twice with moderately hot water.

Dissolving the Salts. Use 2 lbs. 6 ozs. of salts to each gallon of clean water. This will make a solution of density (when cold) 16 degrees on our Nickelometer. In order to dissolve the salts, water should be poured into a heated enamelled-iron vessel or a wooden vessel, and the salts added at the rate of about 4 to 5 lbs. per gallon of water. The solution should be *brought to the boil* and be kept boiling for some ten minutes with constant stirring in order to dissolve *all* the salts.

When everything soluble has dissolved add the solution to the bath

and allow to cool. The bath should have been previously filled with water to about one-quarter its volume. When *all* the salts required for the bath have been dissolved in the way given and the solution is cool the density should be taken, and if found to be too great, water must be added (with constant stirring) until the correct density is obtained; this should be at ordinary temperature 16 degrees on our Nickelometer. *On no account remove any of the scum from the surface of the solution whilst "Nivo" Salts are being dissolved; stir it all in.* The solution is now ready for use.

Special Note. It is to be clearly understood that the salts must not *under any circumstances* be dissolved in a galvanised or plain iron vessel; always use either enamelled iron, wood, or stoneware.

The solution when made up and ready for use will be found to be *slightly acid.* This acidity may be proved by means of neutral tint Litmus Paper, and *must be maintained.*

Anodes. Use a good set of pure Nickel Anodes in the proportion of five cast to one rolled; in a Vat having two rows of work it is necessary to have three rows of anodes. We strongly recommend that *new* anodes are used. If, however, old ones are employed, it is necessary that they should be subjected to the following process before being placed in the solution:—Scour them well with pumice in order to remove all loose particles. Then remove any yellow or black oxide by pickling in a mixture of 10 parts of Sulphuric Acid, 5 parts of Hydrochloric Acid, and 85 parts of water.

After removing the anodes from the pickle, scour them again with pumice, swill in clear water, and finally boil in water for half an hour.

We strongly recommend the pickling process.

The positive rods should be completely filled with anodes: *a poor anode surface is injurious to the bath.* They should be removed from the bath once every week, scoured well, swilled and replaced.

Current. The current density which may be used varies with (1) the material and nature of the surface of the work to be plated; and (2) the object the depositor has in view. As a rule at least twice the current density ordinarily employed may be used with this bath. The plater will, therefore, have wide limits within which to work, and he will soon find by experience what the best conditions are for his particular class or classes of work.

Note. It is essential that both a Voltmeter and Ammeter be used with the "Nivo" bath.

As a solution made from our "Nivo" Nickel Salts will require as much current again as does the Double Nickel Sulphate bath it is necessary to use a resistance board that will carry sufficient current. At the same time the board must control the current to a very low point, so as to enable the operator when filling the Vat to cut down the voltage to a very low figure. Totomuch current on the first few articles put in the Vat will cause them to srip.

No articles should be put into the bath unless the current has been first switched on; nor must the work be left in the Vat at any time unless

current is flowing. If for any cause (*e.g.*, breakdown) the current is stopped whilst work is being plated, the latter must be at once removed and well cleaned and coppered before being replaced in the bath.

Cleaning. The work must be chemically clean. Great care must be taken that all work is free from cleaning or other material before being put into the bath. After the usual cleaning in "Lyco," Potash, or the electric cleaner, the work should be thoroughly scoured and then swilled in clean *running* water. If the articles are of iron or steel they must be dipped in a 5% Sulphuric Acid dip, and finally swilled in clean running water before being put into the bath. The acid dip should be renewed every other day.

Unless the cleaning operations are carried out with the greatest care bad plating will be the result.

Temperature. The solution must not be allowed to fall below 62° Fahr. This is a most important point.

General Directions. If the bath should become too acid after working some time, Carbonate of Nickel in the plastic condition should be added to some solution *taken from the bath.* After boiling up with an excess of carbonate, allow the undissolved solid to settle and return the clear liquid to the bath through a filter, stirring the solution all the time. If necessary, this process must be repeated until the bath has again become only slightly acid.

"Nivo" Salt, being a compound, should all be dissolved; under no condition should part of the salts only be dissolved.

No solid substance should ever be added directly to the bath. Ammonia must never *on any account or for any reason* be added without written instructions from us. *The bath will soon become spoiled if foreign ingredients be allowed to get into it.*

After ceasing work at night the solution should be well stirred and allowed to settle again; it will be ready for working next morning. The solution should always be kept covered when not in work.

CANNING'S "VELETE" NICKEL SOLUTION.

FOR producing a very bright and quick deposit of nickel in a short time. The deposit is such that after 3 to 5 minutes in the solution the article will stand mopping.

Many articles which are of a cheap character may do without the mopping or finishing process.

The solution is specially suitable for Brass and Copper articles *which require only a moderately thick deposit*, such as Cabinet Brass-foundry, Valves for Motor and Cycle Tyres, Photo Frames, Steel Toys, Belt and Brace Buckles, and many similar articles.

Instructions for Making and Working Bright Nickel Solution from Canning's "Velete" Nickel Salts.

See that the Vat is clean, and if an old Vat is used which has contained Nickel Solution see that all salts which have crystallised to the

wood are removed, and scrape all oxide from the wood and wash out well.

Use 1½ lbs. of Salts to 1 gallon of clean water.

In order to dissolve the Salts water should be poured into a vessel (preferably enamelled), heated, and the Salts added at the rate of 2 to 3 lbs. per gallon of water.

The solution should be just brought to the boil, being constantly stirred in order to dissolve all the Salts.

When everything soluble has dissolved add the solution to the bath and allow to cool; the process must be repeated till the Vat is conveniently full when the liquid is cold.

The density must now be taken, and if found to be too great, water must be added (with constant stirring) till the right density is obtained. On no account remove any of the scum from the surface of the solution while "Velete" Salts are being dissolved, but stir it all in. The solution is then ready for use.

Special Note. It is to be clearly understood that the Salts must not under any circumstances be dissolved in a galvanised or plain iron vessel; always use either enamelled iron, wood, or stoneware.

The bath when made up and ready to be worked will be found to be very slightly *acid.*

This acidity may be proved by means of neutral-tint Litmus Papers, *and must be maintained.*

If the bath should become too acid after working some time, carbonate of nickel in the plastic condition may be added to some solution *taken from the bath.*

This solution, after allowing any undissolved carbonate to settle, should be returned to the bath through the filter, and the process must be repeated until the bath has become but slightly *acid.* No solid substance should ever be added directly to the bath.

Ammonia must never, *on any account or for any reasons,* be added without written instructions from us.

The current density which may be used varies with the nature of the surface of the articles to be plated.

As a rule, at least twice the current density ordinarily used may be used with this bath.

The plater will therefore have wide limits within which to work, and he will soon find by experience what the best conditions are for his particular class or classes of work.

The temperature of the solution must not be allowed to fall below 62° Fahr.

The density should be about 10° on our Nickelometer; it must not fall much below this.

No articles should be put in this Vat unless the current has first been switched on.

Use a good set of Pure Nickel Anodes in the proportion of five cast and one rolled. In a Vat having two rows of work it is necessary to have three rows of anodes.

When making up a new "Velete" Nickel Solution and old nickel anodes are used, it is necessary to see that the anodes are clean and free from loose particles, any yellow or black oxide to be removed by pickling the anode in a mixture of 10 parts of Sulphuric Acid, 5 parts of Hydrochloric Acid, and 85 parts of water. Afterwards swill in clean water, then place the anodes in boiling water for about half an hour.

We strongly recommend the acid pickling process.

For export, if acid is not available, the anodes can be scoured with sand, well brushed, and boiled in water for half an hour.

We recommend that new anodes be used.

As a Vat made from our "Velete" Nickel Solution will require nearly as much current again as an ordinary Vat, it is necessary that a resistance board to carry sufficient current is used; at the same time the resistance board must be made to control the current to a very low point, so that when the operator is filling the Vat he can control the current for the first few articles, as too much current makes the nickel strip off.

Great care must be taken that all work has been thoroughly swilled first in clean running water, and for steel pass through a 5% Sulphuric Acid dip, which must be frequently renewed, and finally in clean water again before being put into the Vat. The bath will soon become spoiled if foreign ingredients be allowed to get in it.

It will take longer to get a deposit on steel that will mop, than the time mentioned on the previous page. We do not recommend this Solution for steel generally, though it could be used in certain cases; it is best to use "Nivo" for rapidly depositing nickel on steel work.

The work must be chemically clean. Bad plating is sure to be the result unless this precaution is taken.

After ceasing to work at night the solution should be well stirred and allowed to settle again; it will be ready for working next morning.

"Velete" Salt, being a compound, should all be dissolved; on no account should a part only be dissolved.

BLACK NICKELLING.

THIS is a special solution for producing a Black Nickel deposit. The method of deposition is carried on in the same way as in ordinary White Nickel Plating, using ordinary Nickel Anodes, but a different current.

The work should be first cleaned in Canning's "Lyco" Solution or Brown Potash Solution to remove grease, then scoured and swilled; in fact, treated in exactly the same way as for ordinary nickel plating.

Instructions.

Vat. A lead-lined Vat or an enamelled-iron Vat is used, as for ordinary Nickel-plating.

Solution. Dissolve the "Black Nickelling" Salts in hot or cold water in an enamelled-iron vessel, and bring the Solution just up to the boil—11 oz. of the Salts are required to 1 gallon of water.

Acidity. Acidity, like too much current, causes streaks on the work, and the Solution in such a case should be neutralised with Carbonate of Nickel.

Density. The Solution should be *quite neutral*, and register 6 to 8 on the Nickelometer.

Colour. In order to obtain the black colour it may be necessary from time to time to add Re-charging Fluid in small quantities at a time, the amount depending on the colour of the deposit. If any iridescence is noticeable, it may be removed by lightly mopping the work with a soft Polishing Mop or a Swansdown Mop and Rouge Composition, or by using a thinner Lacquer, or by giving a second coat of Lacquer.

Anodes. The method of deposition is carried on in the same way as in ordinary white nickel-plating, using ordinary Nickel Anodes.

Current. A voltage of 0·3 to 0·6 Volts (or one-third to two-thirds of a Volt) should be used, with a distance of about 4½ to 5 inches between Anode and work.

Cleaning. The work should be first cleaned in Canning's "Lyco" Solution to remove grease, then scoured and swilled—in fact, treated in exactly the same way as for ordinary nickel-plating.

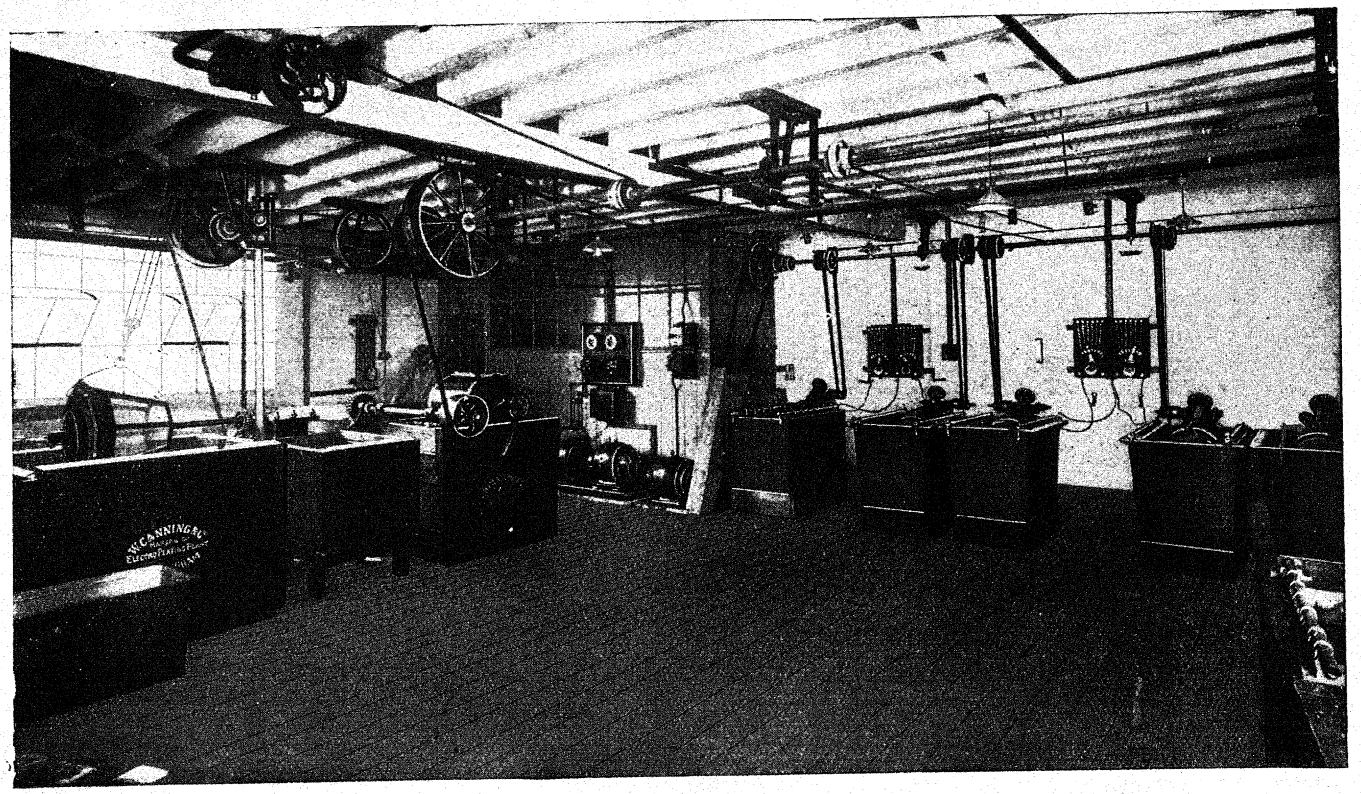
Working. Iron work should be first lightly coppered, brassed, or nickelled, or, even better, electro-zinced. This is not absolutely necessary, but is preferable. The work should be left in the Vat for from forty-five to sixty minutes for particular work, but a shorter time may be sufficient or a longer time necessary. Do not work the bath too quickly. The work should then be well swilled in cold water, then in hot water, and dried out in Boxwood Sawdust in the usual way. It is most advisable to finally lacquer the work to improve the appearance and preserve the surface. A good colourless dip lacquer "Frigilene" should be used, following the instructions given in Section 8 of the Catalogue.

DEVICES FOR ELECTRO-PLATING IN REVOLVING AND OTHER BARRELS.

THE Mechanical Plating of small articles in a barrel, revolving in a solution of the metal to be deposited, has become a very important process, and is being employed largely for the small parts of cycles, buckles, screws, etc. The various metals can be deposited this way successfully, always providing the article to be plated is suitable for barrelling.

The "Forward" Plating and Polishing Apparatus, as illustrated, is a revolving barrel, which runs in the solution. It is made with a wooden bottom and perforated celluloid sides, or wholly of wood, as is required for the different solutions for which it is used.

It has a centre rod which is fixed to the driving attachment, and which is fixed at the head of the Vat (see illustration), and the necessary reduction in speed is obtained by using a suitable worm wheel. By this means the driving of the barrel can be readily adopted to an ordinary line shaft, a shaft running at 200 revolutions per minute, with a pulley about 12 inches

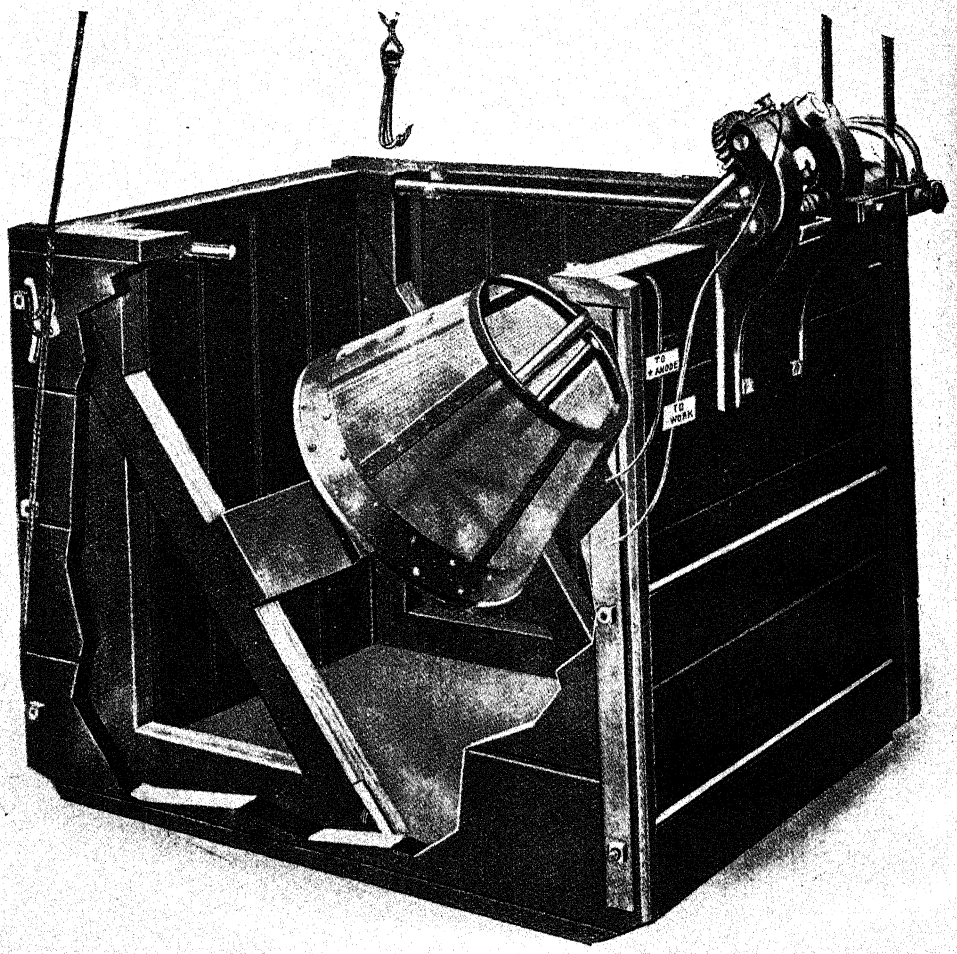


A Modern Plating Shop.

(Showing "Quickplate" and "Forward" Plating Barrels and "Midget" Plating Apparatus.)

in diameter for driving; the fast and loose pulley fixed on the Vat will accomplish the necessary speed of the Barrel. It will thus be seen that a costly countershaft is unnecessary.

The centre rod which conducts the current is insulated by special



THE "FORWARD" PATENT PLATING BARREL.

means, and is also fixed rigidly to the driving mechanism, so that when the Barrel requires to be emptied it is only necessary to attach a hook to it at the bottom and it is raised by means of rope and pulley block; the articles plated are emptied and the Barrel lowered into the Vat; it finds its own bearing.

THE OLD WAY. GIRLS WIRING WORK FOR PLATING.

The principal features of the "Forward" plating Barrel are—

The Barrel runs wholly in the solution, and this permits a large quantity of work to be done at one time.

The quantity of articles which can be put in the Barrel depends upon the article, but care must be used not to put so much in that it is carried round as the Barrel revolves. The weight of the article must also be taken into consideration.

The Barrel is as free as possible from metallic fittings, except at the point of contact with the articles.

The Operator can examine the articles while they are being plated.

The top end of the Barrel, *being open, no resistance is offered to the flow of the current in the Barrel.*

For small articles with fine points, the Barrel is made without any perforations.

While the articles are receiving the deposit of metal, they are rubbing one against another. They are therefore highly burnished or polished, and the deposit is close in grain and mechanically closed by the continual rubbing, making the deposit more durable.

It is impossible to get articles burnt by this process.

The patented construction of the "Forward" Barrel is such that it can be manipulated in its manufacture to the kind of articles that have to be plated.

The "Forward" Apparatus will successfully plate articles with Nickel, Brass, Copper, or Zinc.

A most simple arrangement for raising and lowering the Barrel from and into the solution is by using a rope and pulley blocks.

Directions for Erecting and Setting to Work the "Forward" Plating Apparatus.

Vat. The Vat varies according to the Solution which is to be used. If an Iron Vat is used, a Wood Frame should be fitted on top with earthenware insulators.

Solution. A special Barrelling Solution is used, varying according to the metal required to be deposited.

Depth of Solution. The size of Vat for one Barrel is $42 \times 36 \times 36$ ins. deep inside, and the depth of Solution 30 ins. The total volume of Solution is 164 gallons.

Speed. The Barrel should revolve at a speed of about 20 revolutions per minute, but can be exceeded or reduced according to the work. It can be driven from an ordinary line shaft, running at 200 revolutions per minute, with a pulley about 12 ins. diameter, as the driving attachment for fixing to the Vat has a worm wheel which gives the necessary reduction in speed.

Anodes. The Anode surface should be as large as possible, owing to the large amount of surface of articles in the Barrel.

Hooks. The Anode Hooks must be of sufficient length to allow the Anodes to be suspended at a proper depth.

THE NEW WAY OF PLATING SMALL ARTICLES, SHOWING "FORWARD" PLATING APPARATUS.

Removing Articles from Barrel. A necessary lifting arrangement, consisting of pulley block, rope, and hooks, must be fixed securely above the Vat, high enough to allow the Barrel to be raised clear of the Vat for emptying.

Angle of Barrel. The Barrel should be placed at an angle of 45 degrees in the Vat, so that the articles roll round the sides of the Barrel. If the Barrel is placed at such an acute angle that the bottom of the Barrel is too low in the Solution, the articles will lie on the bottom of the Barrel and not roll.

Shape of Articles. It often happens that articles all of one kind are not suitable for plating in a Barrel by themselves. In such cases cast-iron pieces or steel balls of a suitable shape and size should be put in the Barrel with the articles. This will enable the plating and burnishing process to be a success.

Condition of Articles before Plating. In order to obtain a good burnished appearance it is necessary that the articles be well polished before plating.

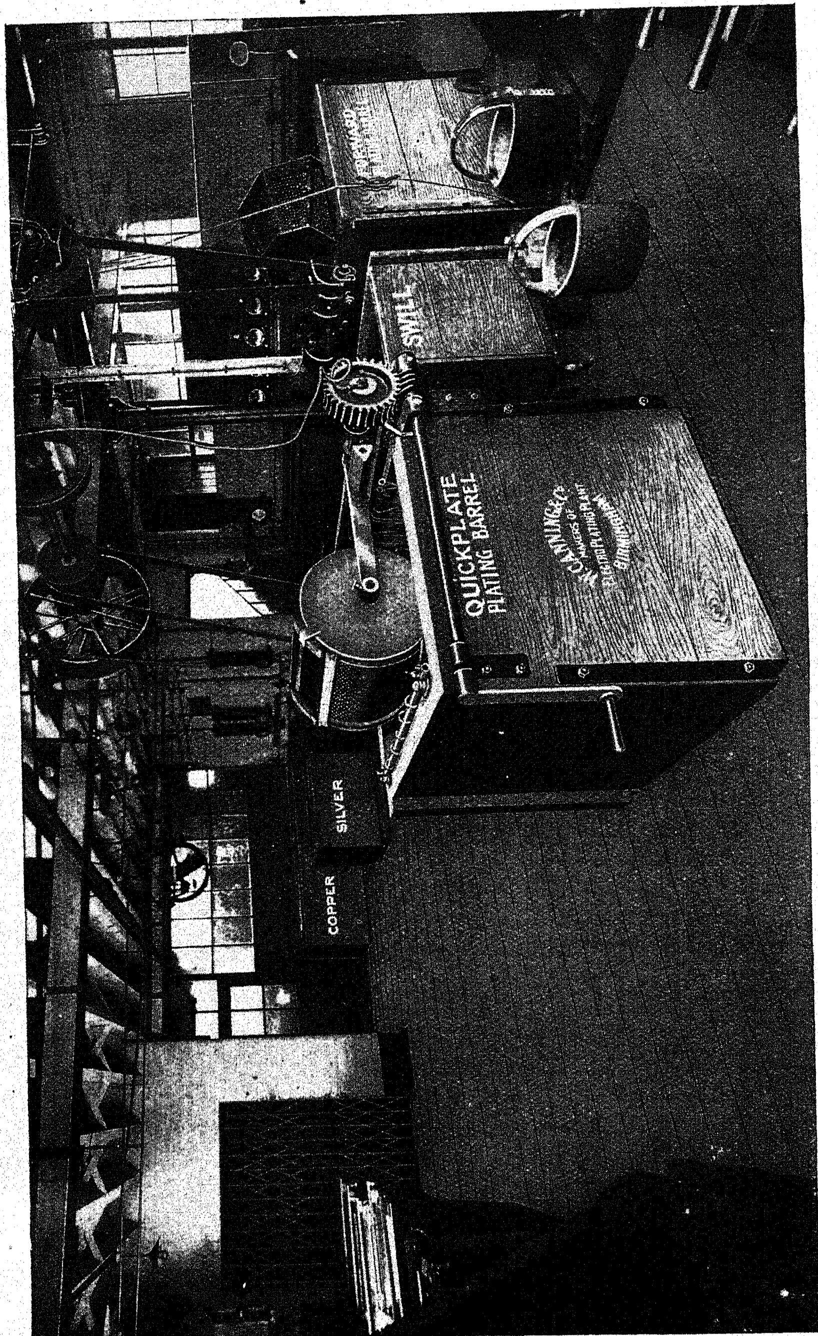
Treatment of Articles before Plating. The articles must be very thoroughly cleaned and freed from grease in the "Lyco" Solution, then thoroughly swilled in clean cold water (brass articles should then be passed through a Solution containing 4 ozs. Cyanide Potassium to 1 gallon of water), and both iron and brass articles passed through an Acid Solution consisting of 5 parts Sulphuric Acid and 95 parts water, then finally well swilled in clean water.

Cleanliness. Great care must be used in the case of hollow articles to remove all cleaning, acid, or other Solution from the inside. If this should be neglected, the Plating Solution will quickly be spoiled on account of the introduction of impurities.

Swilling. When the articles are removed from the Barrel they are allowed to drain, then swilled in clean *cold* water and dried in clean hot boxwood sawdust, or staining will certainly result.

Sawdust. The sawdust must be *clean* and *hot*. For drying out purposes we recommend the use of our Patent Revolving Sawdust Barrel. This Barrel is constructed for the special purpose of keeping the sawdust both hot and dry during the whole process of drying out. It is important to take care that hollow articles are thoroughly dried inside as well as outside (see p. 87).

Current. For Nickel, a current density of from 25 to 40 ampères, according to the quantity and nature of the article. For Brassing, a current of 60 ampères can be used. The use of a Resistance Board for controlling the current and an Ammeter for its measurement is necessary. In actual practice, if the metal is deposited too fast, a good burnished appearance is not obtained. Use all current available during the first half of the time, then reduce to about two-thirds, and leave the articles plating until they have sufficient coat on and a good burnished appearance. The Voltage will determine the current, and the lowest Voltage that should be employed is 6 volts for Nickel and 4½ volts for Brass, at the terminals of Barrel.



MODERN PLATING SHOP, SHOWING "QUICKPLATE" AND "FORWARD" PLATING BARRELS.

Temperature. The temperature of Solution should never be allowed to fall below 62° Fahr.

Load. The amount of articles which can be put into the Barrel depends upon the nature of the articles, care being used not to put in so much that it is carried round with the Barrel and does not roll.

Special Notes. *Never* place articles in Solution until current is switched on.

Don't allow articles accidentally dropped in the Vat to remain; remove them immediately.

See the articles are perfectly clean before placing in Vat.

See the electrical conditions are conducive to good results.

Keep the solution covered when not at work.

No solid substance should ever be added to Solution.

Swill all articles thoroughly. Never allow cleaning or dipping Solution to get into Vat.

Remove any deposited metal on parts of Barrel.

Remove any articles which may get lodged in the Barrel or fall into Solution.

When the Barrel is used intermittently, it must be revolved in Solution each day without current, to keep it from shrinking.

If the Barrel is worked in a lead-lined Vat, be sure that the coach screws do not come in contact with the lead. If Iron Vat is used, the supports must be thoroughly insulated from the Vat.

We recommend *Cast and Rolled Nickel Anodes*, which should cover three sides of the Vat. *It is of great importance in mechanical plating that the surface of Anodes employed is as great as possible, owing to the large amount of surface of articles in the Barrel.*

On the Rods which carry the Anodes, should be placed a protection, to keep the splash of the Solution from corroding the Rods, also to keep the hooks on which the Anodes hang clean. A "V" shaped piece of wood, or indiarubber hose, split, can be used for this purpose.

Particulars of Outfit for One Barrel.

1 "Forward" Patent Plating Barrel, with Frame for standing in Vat, and Lifting Device.

1 Lead Lined Vat, No. 207, 3 ft. 6 × 3 ft. × 3 ft., with Rods and connections for Anodes.

1 Resistance Board with Ammeter 29 B.

Canning's "Britewite" Barrelling Nickel Salts.

9 Pure Nickel Anodes.

18 Nickel Hooks.

2 Cleaning Baskets.

2 Sieves.

Outfits for depositing other metals vary according to the metal.

CANNING'S "QUICKPLATE" PLATING BARREL.

The General Construction of this Barrel is as follows:—It is mounted on a central spindle which is fixed into cast-iron arms on which the Barrel

revolves; current being taken through the arms to the spindle, in which suitable connections to the articles being plated are made.

The Barrel is lowered into the solution so far that the spindle is just above the level of solution; it is found, in actual working experience, that the articles plate well under these conditions.

The Barrel is revolved by a chain driven from the back shaft. The chain of the Barrel is so constructed that it can be lowered and raised to and from the plating bath by turning the handle, as is shown in the illustration. The Barrel can be turned right over into the swilling tank and revolved in it by the same shaft. Therefore the articles are well cleaned of their solution before being removed from the Barrel and the staining of the articles prevented.

The construction of the Barrel itself is free from any complicated parts, having wooden or celluloid walls according to the solution in which the Barrel has to work.

The Barrels with celluloid sides are securely fixed to wooden ends by suitable means; the connections in the Barrel also depend on the work to be plated.

Only experience in the different articles to be plated can decide the size of Barrel required, the size holes to be placed in it, and the shape of the Barrel. Our experience in this direction is at the disposal of intended users.

Particulars of Outfit for "Quickplate" Barrel.

1 "Quickplate" Plating Barrel, inside measurements 18¾ in. long × 18 in. diameter, fitted with lifting gear as illustrated; also fitted with fast and loose pulleys.

1 Plating Vat, 3 × 3 × 3 ft., lined with pure chemical lead (4 lbs. per foot super), burnt joints, matchboarded, wooden frame on top, bolts and plates at end, well painted, as illustrated in Catalogue No. 207.

2 Rods for Vat, 1 in. diameter, No. 237C.

3 Rod Connections, No. 238G, and Brass Clips for fitting on Vat.

1 Resistance Board with Ammeter 29B.

Canning's "Britewite" Barrelling Nickel Salts.

4 Canning's Circular Nickel Anodes, 4 in. wide.

16 Nickel Hooks.

4 Flat Nickel Anodes, 18 × 12 in.

8 Nickel Hooks.

Outfits for depositing other metals vary according to the metal.

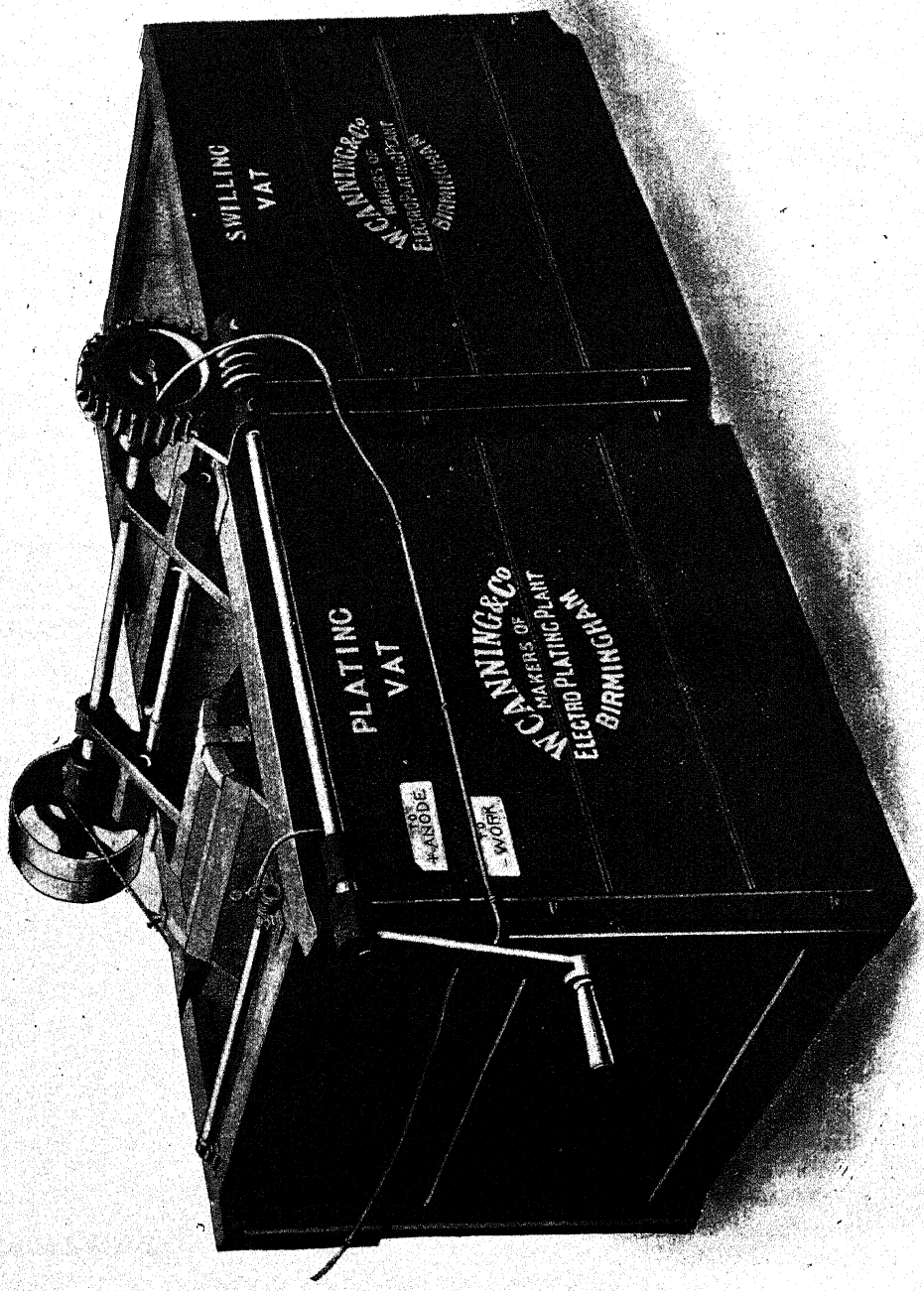
Instructions for Working "Quickplate" Barrel.

Vat. The Vat varies according to the Solution which is to be used. If an Iron Vat is used, a Wood Frame should be fitted on top with earthenware insulators.

Solution. A special Barrelling Solution is used varying according to the metal to be deposited. The total volume of Solution is 112 gallons.

Depth of Solution. The depth of Solution is 25 ins.

Speed. The Barrel should revolve at a speed of about 20 revolutions



CANNING'S "QUICKPLATE" PLATING BARREL.

per minute, but the same can be exceeded or reduced according to the work. It can be driven from an ordinary line shaft running at 200 revolutions per minute with a pulley about 12 ins. diameter, as a driving attachment is fixed on the Vat with a worm wheel, which gives the necessary reduction in speed.

Anodes. The Anode Surface should be as large as possible on account of the large surface of articles in the Barrel. Curved anodes should be placed about 6 ins. under the Barrel, and suspended from each anode rod.

Hooks. The Anode Hooks must be of sufficient length to allow the anodes to be suspended at a proper depth. Usually 15-inch hooks are used.

Removing Articles from Barrel. The Barrel is raised by means of lifting gear fixed on the Vat. The lid is removed, and articles allowed to fall into a sieve.

Swilling. When the articles are removed from the Barrel they are allowed to drain, then swilled in clean *cold* water and dried in clean hot boxwood sawdust, or staining will certainly result. A convenient method of swilling can be used by placing a Swilling Vat at the end of the Plating Barrel. The Barrel can then be swung over and revolved in the Swilling Water (see p. 76).

Shape of Articles. It often happens that articles all of one kind are not suitable for plating in a Barrel by themselves. In such cases cast-iron pieces of a suitable shape and size, or steel balls, should be put into the Barrel with the articles. This will ensure the success of the plating and burnishing process.

Condition of Articles before Plating. In order to obtain a good burnished appearance it is necessary that the articles are well polished before being plated.

Treatment of Articles before Plating. The articles must be very thoroughly cleaned and freed from grease in the "Lyco" Solution, then thoroughly swilled in clean cold water (brass articles should then be passed through a Solution containing 4 ozs. Cyanide Potassium to 1 gallon of water, and well swilled in clean cold water), and both iron and brass articles passed through an Acid Solution consisting of 5 parts Sulphuric Acid and 95 parts water, then finally well swilled in clean water.

Cleanliness. Great care must be used in the case of hollow articles to remove all cleaning, acid, or other Solution from the inside. If this should be neglected, the Plating Solution will quickly be spoiled on account of the introduction of impurities.

Sawdust. The Sawdust must be *clean* and *hot*. For drying-out purposes we recommend the use of our Patent Revolving Sawdust Barrel. This Barrel is constructed for the special purpose of keeping the sawdust both hot and dry during the whole process of drying-out. It is important to take care that hollow articles are thoroughly dried inside as well as outside (see p. 87).

Current. For Nickel, a current density of from 30 to 60 ampères should be employed, according to the quantity and nature of the articles. For Brassing, up to 70 ampères may be used. The use of a Resistance

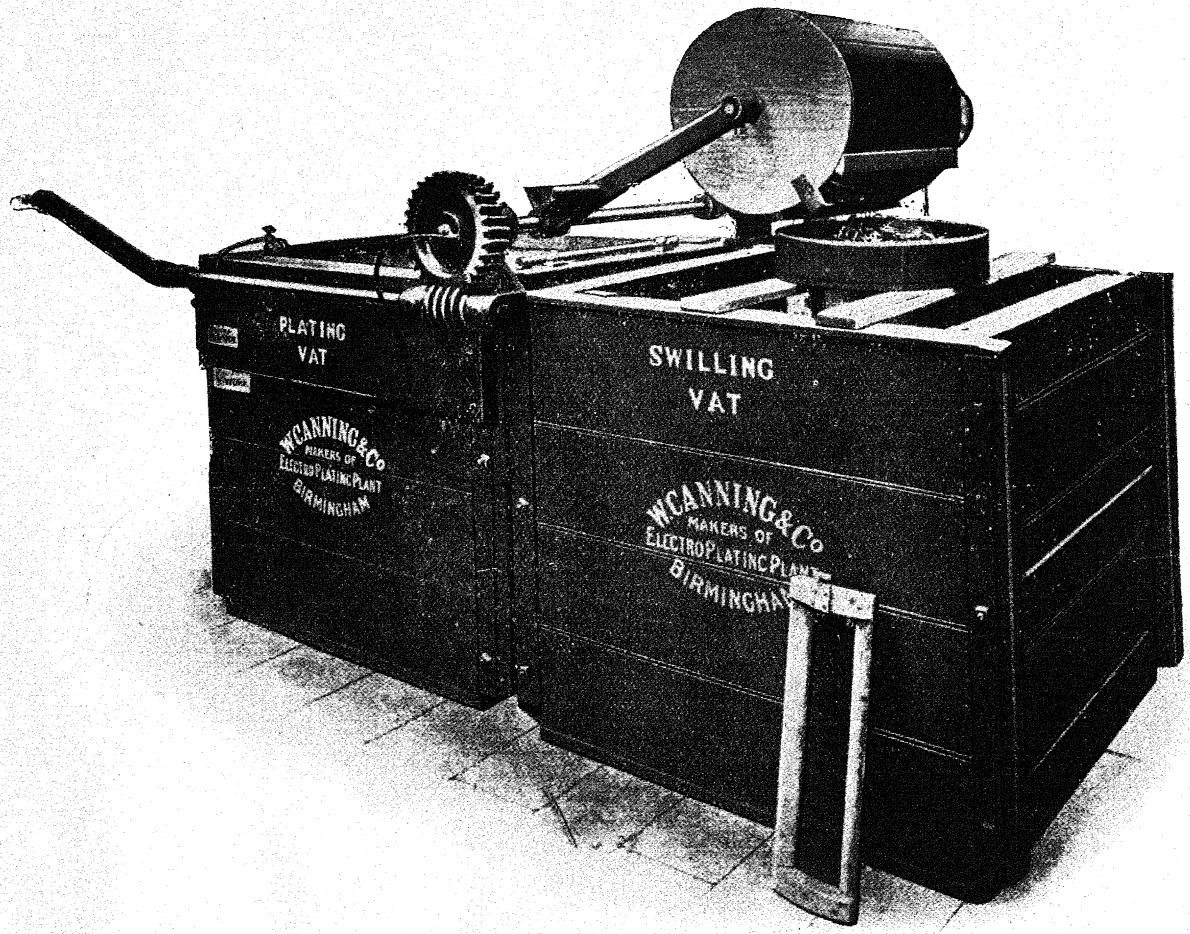


ILLUSTRATION SHOWING "QUICKPLATE" BARREL BEING RAISED FROM VAT AND ARTICLES BEING EMPTIED FROM IT.

Board for controlling the current and an Ammeter for its measurement is necessary. In actual practice, if the metal is deposited too fast, a good burnished appearance is not obtained. Use all current available during the first half of the time, then reduce to about two-thirds, and leave the articles plating until they have sufficient coat on and a good burnished appearance. The Voltage will determine the current, and the lowest Voltage that should be employed is 6 volts in the case of nickel and 4½ volts in the case of brass at the terminals of the Barrel.

Temperature. The Temperature of Solution should never be allowed to fall below 62° Fahr.

Load. The amount of articles which can be put into the Barrel depends upon the nature of the articles, care being used not to put in so much that it is carried round with the Barrel and does not roll.

Special Notes. *Never* place articles in Solution until current is switched on.

Don't allow articles accidentally dropped in Vat to remain; remove them immediately.

See the articles are perfectly clean before placing in Vat.

See the electrical conditions are conducive to good results.

Keep the Solution covered when not at work.

No solid substance should ever be added to Solution.

Swill all articles very thoroughly. Never allow cleaning or dipping Solution to get into Vat.

Remove any deposited metal on parts of Barrel.

Remove any articles which may get lodged in the Barrel or fall into Solution.

When the Barrel is used intermittently, it must be revolved in the Solution each day, without current, to keep it from shrinking.

If the Barrel is worked in a lead-lined Vat, be sure that the coach screws do not come in contact with the lead.

If an Iron Vat is used, the supports must be thoroughly insulated from the Vat.

CANNING'S "MINIK" PLATING BARREL.

This Barrel is similar in construction to the "Quickplate" Barrel, but much smaller, being intended for similar articles where small quantities only are required at a time, when a "Quickplate" Barrel would be unnecessarily large.

The Barrel is made mainly of celluloid, thereby reducing resistance to a minimum.

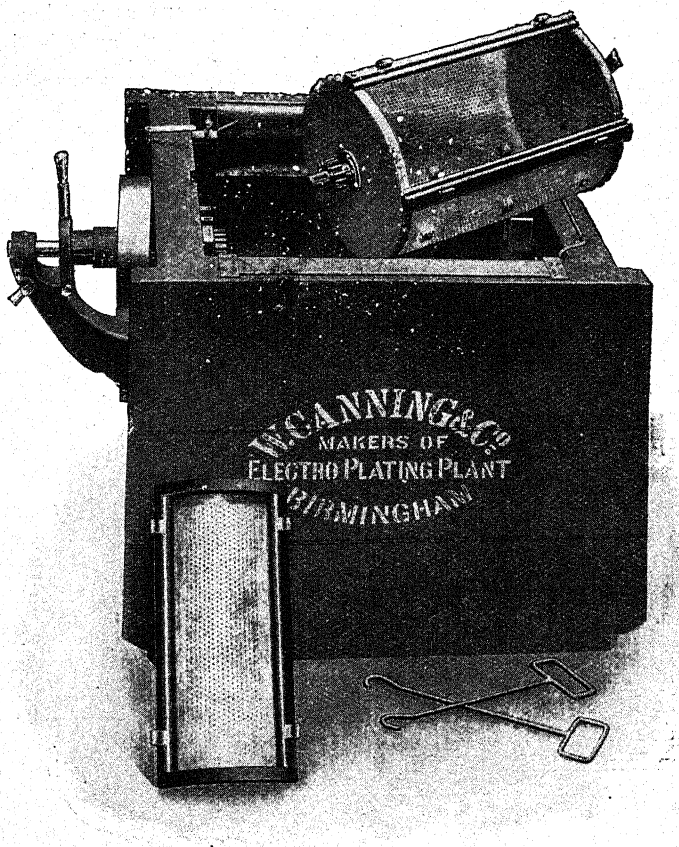
The arrangement for lifting the Barrel from Vat and replacing is very simple.

A Clutch is provided for starting and stopping the Barrel. An idea of the size of the outfit may be gathered by the size of the Vat, which measures 24 ins. square.

The Barrel is suitable for Nickel, Brass, and Zinc plating of sundry

articles, such as screws, rivets, pins, washers, buckles, hooks, springs, bag fittings, lock fittings, etc.

The Barrel can be stopped and removed into swilling water in less than a minute.



CANNING'S "MINIK" PLATING BARREL.

Instructions for Working "Minik" Plating Barrel.

Vat. The Vat varies according to the Solution which is to be used. If an Iron Vat is used, a Wood Frame should be fitted on top with earthenware insulators.

Solution. A special Barrelling Solution is used, varying according to the metal to be deposited. The total volume of Solution is 36 gallons.

Speed. The Barrel should revolve at a speed of about 20 revolutions per minute, but same can be exceeded or reduced according to the work.

Anodes. The Anode Surface should be as large as possible on account of the large surface of articles in the Barrel. Curved anodes should be placed about 6 ins. under the Barrel, and suspended from each anode rod.

Removing Articles from Barrel. The Barrel is readily removed from the Vat by hand. The lid is removed and articles allowed to fall into a sieve.

Swilling. When the articles are removed from the Barrel they are allowed to drain, then swilled in clean *cold* water, and dried in clean hot boxwood sawdust, or staining will certainly result.

Shape of Articles. It often happens that articles all of one kind are not suitable for plating in a Barrel by themselves. In such cases cast-iron pieces of a suitable shape and size, or steel balls, should be put into the Barrel with the articles. This will ensure the success of the plating and burnishing process.

Condition of Articles before Plating. In order to obtain a good burnished appearance it is necessary that the articles are well polished before being plated.

Treatment of Articles before Plating. The articles must be very thoroughly cleaned and freed from grease in the "Lyco" Solution, then thoroughly swilled in clean cold water (brass articles should then be passed through a Solution containing 4 ozs. Cyanide Potassium to 1 gallon of water, and well swilled in clean cold water), and both iron and brass articles passed through an Acid Solution consisting of 5 parts Sulphuric Acid and 95 parts water, then finally well swilled in clean water.

Cleanliness. Great care must be used in the case of hollow articles to remove all cleaning, acid, or other solution from the inside. If this should be neglected the Plating Solution will quickly be spoiled on account of the introduction of impurities.

Sawdust. The Sawdust must be *clean* and *hot*. For drying-out purposes we recommend the use of our Patent Revolving Sawdust Barrel. This Barrel is constructed for the special purpose of keeping the Sawdust both hot and dry during the whole process of drying-out. It is important to take care that hollow articles are thoroughly dried inside as well as outside (see p. 87).

Current. The use of a Resistance Board for controlling the current and an Ammeter for its measurement is necessary. In actual practice, if the metal is deposited too fast, a good burnished appearance is not obtained. Use all current available during the first half of the time, then reduce to about two-thirds, and leave the articles plating until they have sufficient coat on and a good burnished appearance. The Voltage will determine the current, and the lowest Voltage that should be employed is 6 volts in the case of nickel and 4½ volts in the case of brass at the terminals of the Barrel; certain classes of articles will be found to require 9 to 10 volts at first, while for others 7 to 8 volts are best.

Temperature. The Temperature of Solution should never be allowed to fall below 62° Fahr.

Load. The amount of articles which can be put into the Barrel is 1½ gallons, but not less than 1 gallon.

Special Notes. *Never* place articles in solution until current is switched on.

Don't allow articles accidentally dropped in Vat to remain; remove them immediately.

See the articles are perfectly clean before placing in Vat.

See the electrical conditions are conducive to good results.

Keep the Solution covered when not at work.

No solid substance should ever be added to Solution.

Swill all articles very thoroughly. Never allow cleaning or dipping Solution to get into Vat.

Remove any deposited metal on parts of Barrel.

Remove any articles which may get lodged in the Barrel or fall into Solution.

When the Barrel is used intermittently, it must be revolved in the Solution each day, without current, to keep it from shrinking.

If the Barrel is worked in a lead-lined Vat, be sure that the coach screws do not come in contact with the lead.

If an Iron Vat is used, the supports must be thoroughly insulated from the Vat.

"MIDGET" PLATING APPARATUS.

THE Apparatus is so simple in its construction, it has only to be bolted on an ordinary Plating Vat. The Apparatus consists of a suitable Casting in which is held the revolving Carrier for holding the container, which contains the articles being plated.

The Shaft is fitted with the necessary Worm Wheel for reducing the speed.

To the Revolving Carrier is fixed a ring (*a*), into which a suitable Container (*b*), which holds the article, is placed; a simple device is fixed on the Carrier Arm (*c*) to allow the Container to be tilted upright for putting in and taking out readily.

The Container revolves in the solution; Anodes are hung in the Vat in the usual way.

The Container is supplied with holes either ⅛ inch or $\frac{3}{16}$ inch, and we advise one of each is kept in the Plating Shop as a stand-by. The Connecting Strip inside the Container can be so readily removed and replaced that a duplicate Container can be immediately put to work.

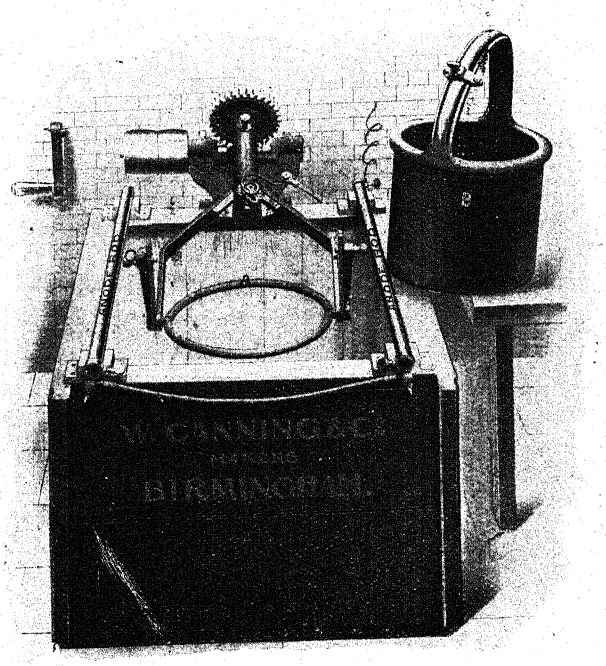
The Apparatus is specially suitable for small quantities of articles, and any quantity up to 4 pints can be done at one time.

Amongst other articles which are being plated successfully are Brass and Iron Nuts, Screws, Cycle Pump Fittings, Tyre Valve Parts, Pedal Pins, Buckles, Curbs, Hooks and Eyes, Small Brass and Iron Articles, Pen Holders, etc.

The special advantage is that such a small quantity of work can be done at one time, which saves sorting.

This is a most inexpensive adjunct to every Plating Shop. It saves wiring, and is specially suitable for Cycle Nuts, Screws, and similar articles. It does not interfere with the thread or the squares of the nuts.

This Apparatus is suitable for depositing Nickel, Brass, Copper, Zinc, Tin, or Silver.



"MIDGET" PLATING APPARATUS.

Instructions for Working "Midget" Plating Apparatus.

Vat. The Vat varies according to the Solution which is to be used. If an Iron Vat is used, a Wood Frame should be fitted on top with earthenware insulators.

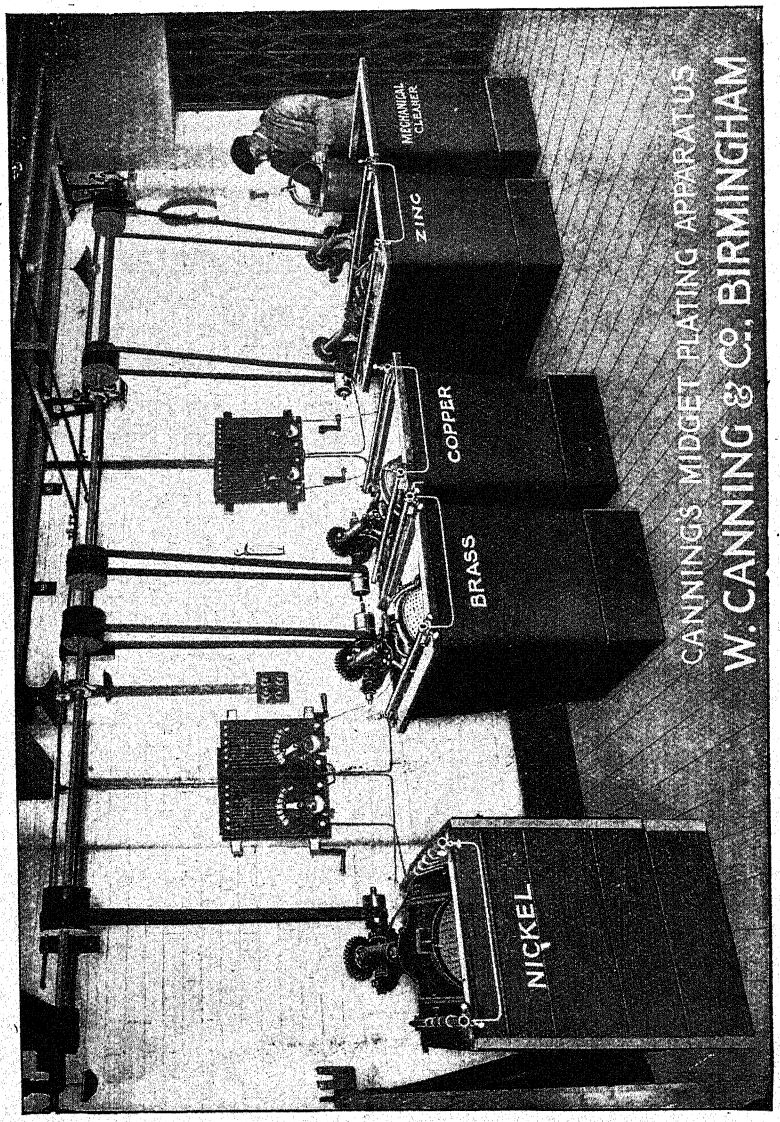
Solution. A special Barrelling Solution is used, varying according to the metal required to be deposited.

Depth of Solution. Depth of Solution is 14 ins. The total volume of Solution is 35 gallons for Nickel. (For some other Solutions a larger Vat is required, so these particulars do not then apply.)

Speed. The Apparatus should revolve at a speed of about 20 revolutions per minute, but can be exceeded or reduced according to the work. It can be driven from an ordinary line shaft, running at 200 revolutions per minute, with a pulley about 12 ins. diameter, as the driving attachment for fitting to the Vat has a worm wheel which gives the necessary reduction in speed.

Anodes. The Anode surface should be as large as possible, owing to the large surface of articles being plated.

Removing Articles from Apparatus. A simple device is fixed on the



Corner of Plating Shop, showing "Midget" Plating Apparatus.

carrier arm of Apparatus to allow the Container to be tilted upright for putting inand taking out regularly.

Shape of Articles. It often happens that articles all of one kind are not suitable for plating in a barrel by themselves. In such cases cast-iron

pieces or steel balls of a suitable shape and size should be put in the Barrel with the articles. This will enable the plating and burnishing process to be a success.

Condition of Articles before Plating. In order to obtain a good burnished appearance it is necessary that the articles be well polished before being plated.

Treatment of Articles before Plating. The articles must be very thoroughly cleaned and freed from grease in the "Lyco" Solution, then thoroughly swilled in clean cold water (Brass articles should then be passed through a Solution containing 4 ozs. Cyanide Potassium to 1 gallon of water, and well swilled in clean cold water), and both Iron and Brass articles passed through an Acid Solution consisting of 5 parts Sulphuric Acid and 95 parts water, then finally well swilled in clean water.

Cleanliness. Great care must be used in the case of hollow articles to remove all cleaning, acid, or other Solution from the inside. If this should be neglected, the plating Solution will quickly be spoiled, on account of the introduction of impurities.

Swilling. When the articles are removed from the container they are allowed to drain, then swilled in clean *cold* water and dried in clean hot boxwood sawdust, or staining will certainly result.

Sawdust. The Sawdust must be *clean* and *hot*. For drying-out purposes we recommend the use of our Patent Revolving Sawdust Barrel. This Barrel is constructed for the special purpose of keeping the sawdust both hot and dry during the whole process of drying out (see page 87).

Current. For Nickel, a current density of 10 to 15 ampères may be employed, according to the quantity and nature of the work. For Brass up to 20 ampères may be used. The use of a Resistance Board for controlling the current and an Ammeter for its measurement is necessary. In actual practice, if the metal is deposited too fast, a good burnished appearance is not obtained. Use all current available during the first half of the time, then reduce to about two-thirds, and leave the articles plating until they have sufficient coat on and a good burnished appearance.

Temperature. The Temperature of Solution should never be allowed to fall below 62° Fahr.

Load. The amount of articles which can be put into the container depends upon the nature of the work. Just sufficient to allow the articles to roll.

Special Notes. *Never* place articles in Solution until current is switched on.

Don't allow articles accidentally dropped in Vat to remain; remove them immediately.

See the articles are perfectly clean before placing in Vat.

See the electrical conditions are conducive to good results.

Keep the Solution covered when not at work.

No solid substance should ever be added to Solution.

Swill all articles very thoroughly. Never allow cleaning or dipping Solution to get into Vat.

Remove any deposited metal from parts of Apparatus.

Remove any article which falls into Solution.

CANNING'S "BRITEWITE" NICKEL BARRELLING SALTS.

THESE Salts produce a very white and bright deposit, and are suitable for articles made in Iron, Steel, or Brass. Our aim in producing the Solution made from our "Britewite" Nickel Salts is to obtain a deposit in a barrel as near in appearance as it is possible to get in a Still Nickel Plating Solution.

Instructions for Making and Working W. Canning & Co.'s "Britewite" Nickel Barrelling Solution.

TO MAKE THE SOLUTION.

Condition of Vat. The Vat in which the Solution is to be used should be perfectly clean. If an old one having contained an ordinary solution is to be used, all crystallized salts, oxides, etc., should be entirely removed. It may even be necessary to remove the matchboarding in order to remove all injurious matter.

Dissolving Salts. Dissolve the salts (the proportion is 1½ to 3 lbs. to 1 gallon of water) in an enamelled iron vessel by filling with water, then add 2 to 3 lbs. "Britewite" Salts to each gallon of water, and well stir until the whole is brought to a boil; continue to boil for some ten minutes, stirring all the time.

Do not use any vessel except one of enamelled iron for mixing the solution, and do not remove any "scum" which appears upon top of the solution, but stir till all is dissolved.

Placing Solution in Vat. The Solution can then be poured through a filter into the Vat and the process continued till the whole of the salts supplied are dissolved. Add cold water, stirring while doing so, until the density is 10° on Canning's Nickelometer, if 1½ lbs. of the salts are used to the gallon of water; but the density will be 20° if 3 lbs. of the salts are used per gallon of water.

Acidity. The Solution is now ready for use and will be found to be *very slightly acid*. The acidity must be maintained. If necessary a very little Sulphuric Acid must be added from time to time in order to keep the bath just on the acid side.

Temperature of Solution. The temperature of Solution should never be allowed to fall below 62° Fahr.

Anodes. Use a good set of pure nickel Anodes in the proportion of five cast to one rolled. If Anodes which have been used in an ordinary Solution are used, they must be made perfectly clean by pickling in a mixture of 10 parts of Sulphuric Acid, 5 parts Hydrochloric Acid, and 85 parts of water, afterwards swill in clean water, then place them in boiling water for about half an hour. We strongly recommend the acid pickling process.

Special Notes. *Never* place articles in Solution until current is switched on.

Don't allow articles accidentally dropped in Vat to remain—remove them immediately.

See the articles are perfectly clean before placing in Vat.

See the electrical conditions are conducive to good results.

Keep the Solution covered when not at work.

Never add Ammonia to Solution.

No solid substance should ever be added to Solution.

Swill all articles very thoroughly. Never allow cleaning or dipping solution to get into Vat.

Replenishing the Bath. This is only occasionally necessary. Nothing must on any account be added for purpose of replenishing except such Salts as are supplied by us for that purpose.

"Britewite" Salt being a compound, the whole quantity should be dissolved; under no conditions should part of the salts be used.

CANNING'S "ALBO" NICKEL BARRELLING SALTS.

FOR producing a good brilliant deposit in a Barrel. These Salts we have made for many years, but have improved their Composition to bring them up to the present high state of perfection for which they are made. The Solution is specially suitable for plating Brass Articles in a Revolving Barrel. Use 18 ozs. "Albo" Nickel Barrelling Salts to 1 gallon of water.

Instructions for Making and Working W. Canning & Co.'s "Albo" Nickel Barrelling Solution.

TO MAKE THE SOLUTION.

Condition of Vat. The Vat in which the Solution is to be used should be perfectly clean. If an old one having contained an ordinary solution is to be used, all crystallised salts, oxides, etc., should be entirely removed. It may even be necessary to remove the matchboarding in order to remove all injurious matter.

Dissolving Salts. Dissolve the salts (the proportion is 18 ozs. to 1 gallon of water) in an enamelled iron vessel by filling with water, then add 1 to 2 lbs. "Albo" Salts to each gallon of water, and well stir until the whole is brought to a boil; continue to boil for some ten minutes, stirring all the time. Do not use any vessel except one of enamelled iron for mixing the Solution, and do not remove any "scum" which appears on top of the Solution, but stir till all is dissolved.

Placing Solution in Vat. The Solution can then be poured through a filter into the Vat and the process repeated till the whole of the salts supplied are dissolved. Add cold water, stirring while doing so, until the density is 9° to 10° on Canning's Nickelometer.

Acidity of Bath. The Solution is now ready for use, and will be found to be very slightly acid. The acidity will soon work off and the bath become neutral. If it should become Alkaline, add just sufficient pure Sulphuric Acid to bring it back to a neutral condition.

Temperature of Solution. The temperature of Solution should never be allowed to fall below 62° Fahr.

Anodes. Use a good set of pure nickel Anodes in the proportion of five cast to one rolled. If Anodes which have been used in an ordinary

Solution are used, they must be made perfectly clean by pickling in a mixture of 10 parts of Sulphuric Acid, 5 parts Hydrochloric Acid, and 85 parts of water; afterwards swill in clean water, then place the Anodes in boiling water for about half an hour. We strongly recommend the acid pickling process.

Special Notes. *Never* place articles in Solution until current is switched on.

Don't allow articles accidentally dropped in Vat to remain—remove them immediately.

See the articles are perfectly clean before placing in Vat.

See the Electrical conditions are conducive to good results.

Keep the Solution covered when not at work.

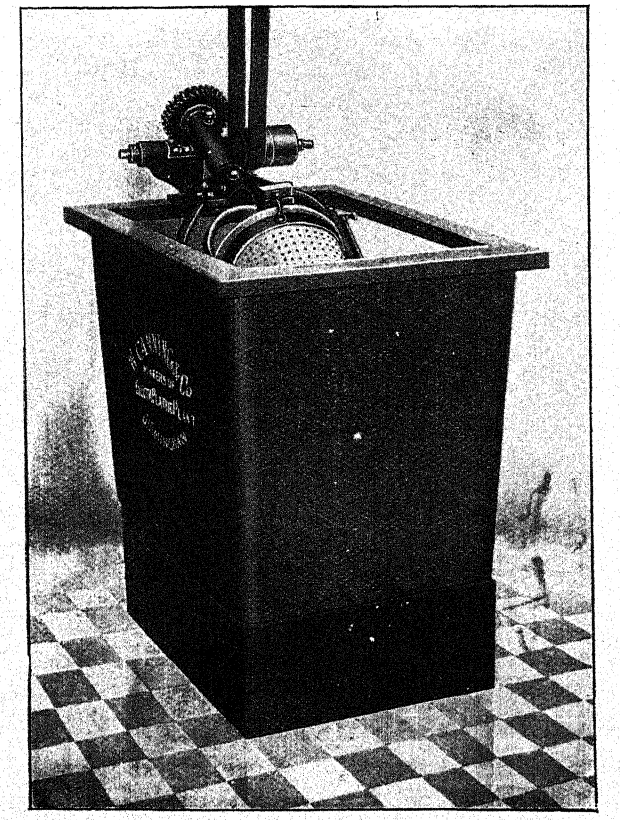
Never add Ammonia to Solution.

No solid substance should ever be added to Solution.

Swill all articles very thoroughly.

Never allow cleaning or dipping solution to get into Vat.

Replenishing the Bath. In order to replenish the Bath with metal, it will be found advisable to add Single Nickel Salts from time to time.



CANNING'S MECHANICAL CLEANER.

CANNING'S MECHANICAL CLEANER.

THIS is specially designed for cleaning small articles preparatory to plating, and is used in conjunction with "Midget" and "Minik" Plating Apparatus or Plating Barrels generally.

Where a quantity of small articles have to be handled, or where the articles are of such a description that it is difficult to scour them, the continual rubbing together of the articles in this apparatus cleans them, and, in addition, brightens them.

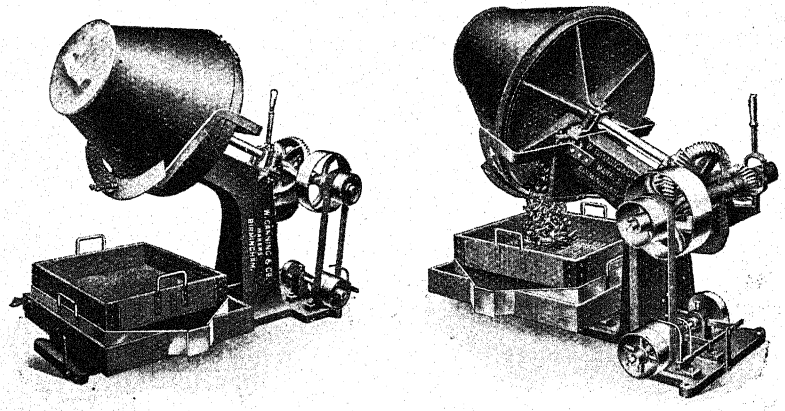
It is very useful, where articles have been dipped in acid to remove rust and require a certain amount of brightness.

The Apparatus consists of an earthenware Container and Driving Gear similar to the "Midget" Apparatus. It should be fitted to an iron tank and revolved in a Solution of "Lyco" ($\frac{3}{4}$ lb. to 1 gallon cold water).

DRYING OUT AFTER BARREL PLATING.

FOR drying out articles in sawdust, especially small articles which are plated in bulk in a Plating Barrel, a Sawdust Drying Out Barrel as illustrated should be used.

The Barrel is open to allow of ready access to the articles being dried; it is also fitted with a suitable gas burner, which heats the water in the jacket, the Barrel having an inner and outer casing between which is water to prevent the sawdust burning.



The Barrel illustrated is mounted on a substantial cast-iron pedestal, and is fitted with a suitable pulley for driving, necessary bevel gear, self-contained countershaft with belt-shifting device for starting and stopping the Riddling Tray, and a clutch for starting and stopping the Barrel.

The bottom of the Barrel is fitted with a hinged door for emptying the work and sawdust falling into the special Riddling Tray, which fits into a galvanised iron pan, arranged with a mouth for conveniently emptying the sawdust back into the Barrel.

The Riddling Tray is operated from the foot of the pedestal, as shown in the illustration (p. 87), by means of the Countershaft shown, and a Disc eccentric and connecting rod imparts a rapid backward and forward motion to the tray.

By this means the sawdust is effectually separated from the work, and falls into the pan underneath, and is ready for use again.

The Water Jacket is provided with two screwed plugs for filling with water, emptying, and washing out. The riddling of work and sawdust is done automatically instead of by hand. It is possible to run the Barrel only, or the Riddling Tray only, or both Barrel and Riddling Tray together, or have both stationary, by means of the clutch and countershaft fitted to the pedestal, the belt driving the Barrel pulley continuously.

The heat can be regulated to a nicety, and 4 gallons or a handful of work can be efficiently dried out at a time.

The movement and expeditious drying-out by means of this Barrel improves the finish of the work.

ELECTROLYTIC CLEANING.

THE *process of cleaning work preparatory to plating by the use of an electric current has proved successful, and its adoption in works which have to treat with large quantities is becoming very general.*

The extra plant required for the process consists of an iron Vat (preferably of the welded type ; see page 18), *with arrangement for heating Solution, by either gas, fire, or steam. The tank must be fitted with Anode and Cathode Rods as for a plating Vat, and a wood frame for carrying them. The Anodes consist of carbon plates.* A specially constructed resistance board, as illustrated (p. 89), is necessary, so made that the current may be reversed without removing the articles operated upon.

The reversion is effected at the resistance board by moving the lever. When the lever is in a vertical position the current is broken. By moving the lever to the left, the negative pole is in connection with the central or Cathode Rod, from which the work is suspended, and the flow of current is increased as the lever is moved to each succeeding stud.

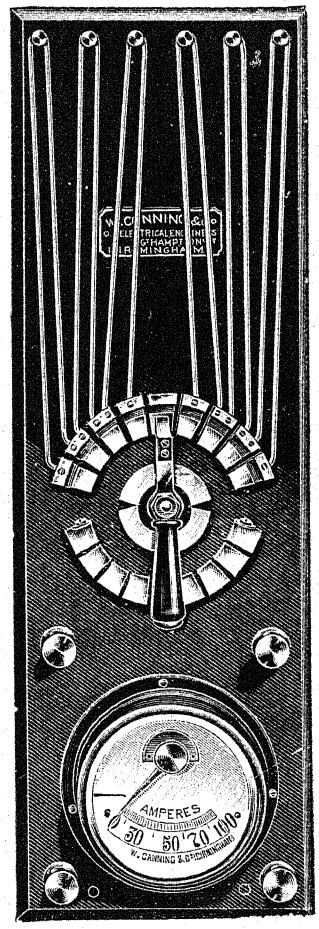
For reversion of the current, the lever is moved to its vertical position, when the circuit is broken, and by moving it to the right the positive pole is connected to the central rod, thereby converting the suspended work into an Anode. The Solution is made by dissolving 1 lb. of Canning's Special "Electrolytic Salts" in 1 gallon of water.

The work is wired as for plating, and placed upon the central rod. The current is then put on and regulated at the Resistance Board, according to the amount of work to be acted upon.

The current available should be sufficient to create a rapid evolution of gas at the Cathode, and as this rises to the surface of the Solution it will carry with it the grease and dirt from the Cathode in the form of a dirty scum.

In a short time the work will appear discoloured or oxidised, when the current must be reversed, and the work becomes an Anode.

The action of the reversed current will remove the oxide formed on the surface of the work, which will appear quite bright in appearance and chemically clean. If the articles are moderately clean, they may be put into the electrolytic Vat direct from the wiring-bench. If, however, the work is very greasy, it is advisable to put them for a short time into the "Lyco" Solution, not because it is absolutely necessary, but it is economy of time, for the reason that the hard, greasy formation (from polishing processes) which accumulates on such parts as the burr side of chain wheels, or in the angles at the junction of the tubes and lugs of handle-bars, and similar articles, would take a much longer time to remove than the other parts of the work in the electrolytic Vat.



CHANGE-OVER RESISTANCE BOARD FOR ELECTROLYTIC CLEANING.

By putting them in the "Lyco," this dirt is loosened, and is acted upon in the electrolytic Vat as readily as the other or cleaner parts.

The time occupied in the electrolytic Vat varies according to the state of the work and the material to be acted upon. There is no actual rule as to time, but it must depend upon the experience and intelligence of the operator.

It may be stated generally that with Solution at proper strength and heat, the process occupies from 5 or 6 minutes for steel or iron work.

When the work is removed from the electrolytic Vat, it should be swilled in clean cold water, and examined to see if perfectly clean, in the same manner as after ordinary scouring. If there has been a great accumulation of grease at such points as already specified, a brush with clean cold water will remove it. Scouring powder is seldom required. After the work has been removed from the cleaning solution and swilled, it should be dipped in a bath of weak acid consisting of :—

Water	1 gallon.
Commercial Hydrochloric Acid	4 ozs.
Sulphuric Acid	6 „

Then well swilled in cold water, and immediately hung in the plating Vat.

If brass work is cleaned in this Solution it should be allowed to stay in the Solution a very short time, about 2 to 3 minutes, and in the case of such metals the current must not be reversed, the articles always, beingused as the cathode, then passed through a Solution of Cyanide of Potassium (99 to 100 per cent.), ½ lb., water 1 gallon, then swilled and hung in the plating Vat.

This Solution is only recommended for iron and steel articles. For brass and copper always use " Klenewell " Solution.

The density of the Electro Cleaning Solution when made is about 12 on Nickelometer at 60° Fahr.

Electro Cleaning Salts must be added from time to time to keep the Solution to this density. If the density is taken at 180° Fahr., it reads about 9 on a Nickelometer.

The Solution must be skimmed every morning while it is cold, to remove all the saponified grease, which rises to the surface. The tank should be cleaned out about every 2 or 3 months. Allow the Solution to settle; syphon off the clear Solution, and remove dirt or sediment from bottom of the tank; replace the clear Solution, and replenish with fresh Salts, and an entirely new Solution made about every 6 months.

Keep the Anodes and hooks clean. Keep the Rods clean and connections screwed up.

The Solution should be used at 160° to 180° Fahr.

KLENEWELL " SOLUTION FOR CLEANING COPPER, BRASS, OR IRON ARTICLES BY ELECTRIC CURRENT.

This Solution is used cold. It is placed in an iron tank, preferably welded (see No. 212; page 18).

This Solution is good for brass work, and is being used also in factories plating iron and steel articles, but it is not recommended where any soft metal is included in the articles, such as soft solder, zinc, lead, tin, etc.

On the top of the Vat is placed a wooden frame, to insulate the current from contact with the Vat.

Down the centre of the tank, on the top of the wooden frame, is placed the Cathode Rod, which is connected with the negative pole of the dynamo, and on this rod is placed the work to be cleaned. On the two anode rods are placed Carbon Anodes.

Current. Use 6 volts and current in ampères in proportion to the amount of work in the cleaning tank at one time.

When the articles are being cleaned they should be spread along the rod in a similar manner as for plating, and allowed to remain in the Solution till clean, generally from one to five minutes. If a quantity of small work is being treated it should be spread out to allow the current to attack all the articles.

The top of the Solution should be frequently skimmed to keep the surface clean.

The Solution should be syphoned off about once a month, and the solids removed from the bottom of the Vat, and the Solution strengthened by the addition of fresh "Klenewell" Salts. An entirely new Solution should be used about every six months.

To make the Solution use—

Canning's "Klenewell" Salts	¾ lb.
Water	1 gallon.

For a 3×2×2 ft. Vat add about ½ lb. "Klenewell" Salts per day, more or less, according to the quantity of work put through.

Use Solution cold, which should register 7° to 12° on Canning's Nickelometer.

It must be clearly understood that when the articles are very dirty or have a quantity of polishing composition clinging in lumps, they should be put in a solution of Canning's "Lyco" or Potash for a short time, to soften the hard dirty material.

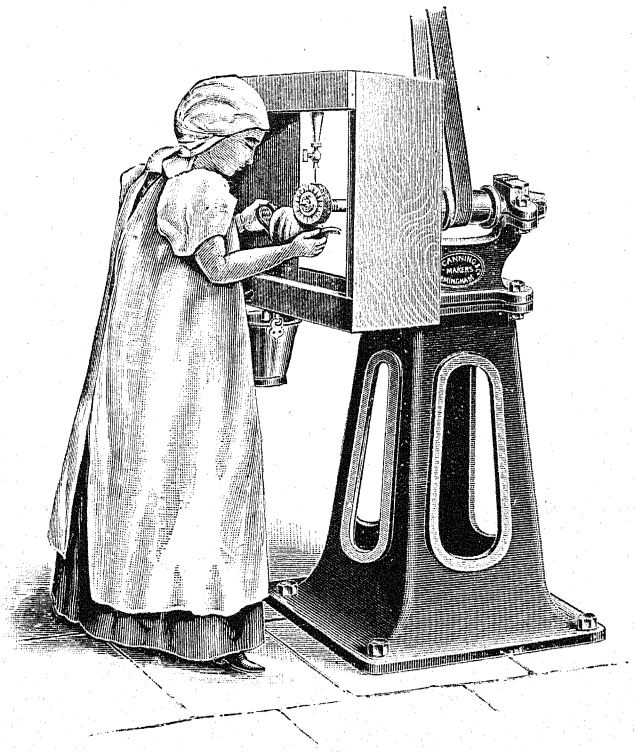
ELECTRO-BRASSING OR COPPERING (IN CYANIDE SOLUTION).

THE instructions for preparing articles for Electro-brassing and Coppering are the same, therefore it is not our intention to print both. The directions as to working the Solution differ.

The Vats used for Brass or Copper Solutions: if the Solution is used cold, a Wooden Vat lined with lead (see page 17); or if the Solution is used warm, a plain Iron (see page 19) or Enamelled Vat. Lamp Stands, Stoves, Grates, and any large articles made of cast, malleable, or wrought iron, should be examined to see if there is any scale on them. If there is, they must be dipped in a Solution consisting of 7½ parts Sulphuric Acid, 2½ parts Hydrochloric Acid and 90 parts water. Allow the articles to remain in the Acid Solution for a short time (which depends upon the amount of scale on the article)—from 5 to 15 minutes is generally sufficient. If the Acid Solution is warmed, it will work much quicker—then remove the articles from the Acid Solution, swill in clean water, scratch-brush or brush with powdered pumice till all scale is removed. Whilst the scratch-brush is revolving, a gentle stream of water is allowed to fall on the surface, to swill away any dirt. Swill the article well in cold water, attach a piece of copper wire, then place it in the Solution; after a few minutes examine it to see if the deposit is uniform; if so, allow it to continue. If, on the other hand, it is patchy or looks black, take it from the Solution, scratch-brush it again, as before described, and replace it in the Solution for 30 minutes (if Solution is cold), when a good heavy deposit is obtained. An equally good result is obtained in 15 to 20 minutes if Solution is worked warm. Articles which are required to be done cheaply are only left in the Solution a few minutes till covered all over.

The best results for Electro-brassing are obtained by first giving the articles a coat of Copper; when it is well coated, scratch-brush and place in the Brassing Vat till the desired thickness of deposit is obtained.

Electro-brassing or Coppering Small Articles. Small articles which are bright or have been well polished in the shaking-barrel can be wired up in strings (care being taken that they will not hang below the Anodes in the Solution) or plated in a Mechanical Plating Barrel (see page 64). Swill through the Hot Cleaning Solution, then swill well through clean water; and if the articles then show any grease marks, they must be



ILLUSTRATING THE PROCESS OF SCRATCH-BRUSHING.

scoured in the usual way with powdered pumice-stone; finally, swill through clean water and place in the Vat.

If the articles are clean from grease and have scale on, shake them in a wooden Barrel (see page 47) in the following Acid Solution, using same at about 90° Fahr. :—

Sulphuric Acid	10 parts.
Water	90 „

After they have been shaken about 10 minutes, they are ready for swilling and plating; the length of time required in the shaking barrels depends altogether on the condition of the articles under operation.

If Plating Solution is in good order, 30 minutes in a Solution worked cold, or a few minutes in a Solution worked hot, is often sufficient; but

the time the articles are left in the solution depends upon the thickness of the deposit required.

After the articles are taken from the Solution, *well swill in cold*, then in hot water, and dry out in the boxwood sawdust. The articles should then show a good uniform colour of the deposited metal.

When a Special Finish is required, the articles should be scratch-brushed after swilling, when taken from the Solution; after scratch-brushing, they should be swilled and dried out in sawdust or shaken in a barrel.

The Anodes should be as large as possible and line each side of the Vat.

CANNING'S "PINK COPPER" SOLUTION.

WHEN a Copper Solution is required for giving a thick deposit of Copper on iron articles, our "Pink Copper" Salts, with the addition of "Zonax" Brand Cyanide Potassium, 95%, gives excellent results.

The Salts are made from chemically pure Copper; the special process employed in the making enables us to get far more metal (Copper) into the Salts than any other Copper Salts on the market.

We claim that for thick deposits of Copper in a Cyanide Solution these Salts are invaluable.

"Pink Copper" Salts can be added to any existing Cyanide Copper Solution.

The price at which the Salts are offered compares favourably when the high percentage of metal they contain is taken into consideration.

No chemicals other than Canning's "Pink Copper" Cyanide Potassium or Bisulphite Soda must be added to our "Pink Copper" Solution.

Instructions for Working "Pink Copper" Solution.

Condition of Vat. The Vat in which the Solution is placed should be perfectly clean. If the Solution is used hot, a Vat made with enamelled iron or plain iron can be used; if Solution is used cold, an enamelled iron, plain iron, or a wooden, lead-lined Vat can be used.

Dissolving the Salts. *To Work Cold.* In a suitable enamelled iron, earthenware, or wooden vessel dissolve 7 ozs. of Cyanide of Potassium (Single Salt, Grey, "Zonax" Brand) in 1 quart of water; when dissolved, add gradually 4½ ozs. "Pink Copper," which will be taken up in the Cyanide Potassium Solution. In another 2 quarts of cold water dissolve 3½ ozs. Bisulphite Soda, and add the two Solutions together, making 3 quarts in all; then raise the whole to boiling and allow to cool, constantly stirring. When quite cold, pass the Solution through a Felt Filter Bag (the sediment will not dissolve), then add 1 quart of water to the Filtered Solution, the whole making 1 gallon. The density must be kept at 9° to 11° on Canning's Nickelometer, at 62° Fahr.

To Work Hot. Dissolve 8 ozs. of Cyanide Potassium (Single Salt, Grey, "Zonax" Brand) in ½ gallon of water. Heat the Solution to nearly boiling, adding gradually 5 ozs. "Pink Copper," constantly stirring the

Solution. After all is added, raise the temperature to boiling-point and allow to cool, then filter as described for the cold bath. When filtered, add ½ gallon of cold water and well mix; this makes 1 gallon of Solution. The density must be kept at 6° to 7° on Nickelometer, at 135° Fahr.

Temperature of Solution. If used cold the Temperature of the Solution should not be allowed to fall below 62° Fahr.; if used warm, 130° to 160° Fahr.

Anodes. Line the Vat with Electrolytic Rolled Copper Anodes. If the Vat is not used for days together, remove the Anodes from the Vat and put same in a Cyanide of Potassium Solution (4 ozs. to 1 gallon of water), or swill well after removing from the Solution, and before replacing scour the surface with sand.

Working and Replenishing the Solution. When the Solution is working properly, the Anodes should be brown or dark brown. If the Anodes are bright, it indicates the presence of too much free Cyanide Potassium, and "Pink Copper" must be added as given below; little or no copper deposit indicates too much Cyanide of Potassium being present, and "Pink Copper" must be added as given below. If a green or white deposit is shown on the Anodes, it indicates that the Solution requires the addition of Cyanide of Potassium. If the deposition is sluggish, add some Bisulphite of Soda.

To replenish with "Pink Copper" Salts, either the cold or hot Solution, take 3 or 4 lbs. of Cyanide Potassium (Single Salt, Grey, "Zonax" Brand) and dissolve it in 1 gallon of hot water, then boil and add "Pink Copper" in small quantities and stir in until no more will dissolve; then add a little more "Pink Copper" and boil for about fifteen minutes to make sure that the Potassium Cyanide is saturated with Copper. This replenishing Solution should be added to the bath in proportion as copper is required.

Special Notes. Don't allow the articles accidentally dropped in Vat to remain; remove them immediately.

See the articles are perfectly clean before placing in Vat.

See the Electrical Conditions are conducive to good results.

Never add Ammonia to the Solution.

No solid substance should ever be added to the Solution.

When the article is taken from the Vat it should be swilled in cold running water, then left in hot water (about 180° Fahr.) for five to ten minutes, and finally dried out in dry boxwood sawdust.

No chemical other than Canning's "Pink Copper" Salts, Cyanide Potassium, or Bisulphite Soda, must be added to our "Pink Copper" Solution.

Ammonia in any form must be avoided.

Another Copper Solution to work either hot or cold is made as follows :—

Canning's "Zonax" Copper Salts	8 ozs.
Water, cold	1 gallon.

Dissolve the Salts in the water, and if the Solution is used cold, work at 65° Fahr. ; if warm, about 120° Fahr. A quicker and brighter deposit

will be obtained by using the Solution warm. Work at 3 volts for a distance of 6 ins. from Anodes to Cathode, and increase ½ volt for every 2 ins. extra distance. If an oxide forms on the Anodes when working, add carefully about ½ oz. Cyanide Potassium, "Zonax" Brand, 95% Grey, to each gallon of Solution, or more or less as required to keep the Anode clean.

A small quantity of the "Zonax" Copper Salts should be added to the Solution from time to time to keep it in proper working condition.

Density should be 5° to 6° on our Nickelometer.

For *Cast Iron Work* add to each gallon of Solution 2½ ozs. Bisulphite Soda, 1¼ ozs. Carbonate Soda.

Another Copper Solution to work either hot or cold :—

Cyanide of Potassium, pure "Zonax" Brand	8 ozs.
Carbonate Copper	6 ozs.
Carbonate Soda	3 ozs.
Bisulphite Soda	2 ozs.
Water	1 gallon.

In making the Solution, dissolve the Cyanide of Potassium in 3 quarts of hot water, and then add the Carbonate of Copper. In another vessel dissolve the Carbonate of Soda and the Bisulphite Soda in the remaining 1 quart of hot water. When the two Solutions are cold, they should be mixed together and thoroughly stirred. If the Solution is used hot, it should be used at a temperature of about 120° to 140° Fahr.

When the Solution is made it will register about 16 on a No. 1 Twaddle Hydrometer, and it is important to keep the Solution as near this density as possible. If the Solution is used hot, water should be added each day to make up for the evaporation of the Solution.

If tin work is to be Copper-plated, we recommend a Solution of half the strength by using half the chemicals in the same proportions as above, and keeping the density of the Solution at 8 on a No. 1 Twaddle Hydrometer. Use the Solution at about 120° Fahr.

Voltage across the terminals of the Vat, 2 to 6 Volts.

If the Solution becomes cloudy and the deposit is a bad colour, it indicates that Cyanide of Potassium requires adding.

If the deposit is rough and rubs off, add a little Carbonate of Copper mixed into a paste with Liquid Ammonia.

If the Solution throws up a quantity of gas when working, and it is not depositing any metal, this is an indication of too much free Cyanide Potassium ; add some Carbonate of Copper mixed into a paste with Liquid Ammonia.

In places where it is impracticable to get Liquid Ammonia, or the carriage on the same is prohibitive, Carbonate of Ammonia can be used ; but it is necessary that the same is dissolved to a saturated solution before it is added to the other chemicals as described.

For further instructions on Copper-plating cycle parts see page 49.

Brass Solution, to work either hot or cold :—

Canning's " Zonax " Copper Salts	8 ozs.
Canning's " Zonax " Zinc Salts	4 ozs.
Liquid Ammonia	¼ oz. to ½ oz.
Water, cold	1 gallon.

We recommend the " Zonax " Zinc Salts being added gradually until the proper shade is obtained.

Dissolve the " Zonax " Salts in the water, and if the Solution is used cold, work at 65° Fahr.; if warm, about 120° Fahr. A quicker and brighter deposit is obtained by using the Solution warm. Work at 3 volts for a distance of 6 ins. from Anodes to Cathode, and increase ½ volt for every 2 ins. extra distance. If an oxide forms on the Anodes when working, add about ½ oz. Cyanide Potassium, " Zonax " Brand, 95% Grey, to each gallon of Solution, or more or less as required to keep the Anodes clean.

If the deposit on the article during the process of plating is too white, add a small quantity of " Zonax " Copper Salts; on the other hand, if the deposit is too red or copper colour, add " Zonax " Zinc Salts to correct the colour ; add either in very small quantities.

Density should be 7° to 8° on our Nickelometer.

For *Cast Iron* and *Lead Work* add to each gallon of Solution 2½ ozs. Bisulphite Soda, and 1¼ ozs. Carbonate Soda.

Another Solution to work hot or cold is made in the following manner:—

Cyanide of Potassium, Single, Salt, 95% Grey, " Zonax " Brand	1 lb.
Carbonate Copper	½ „
Carbonate Zinc	2 ozs.
Bicarbonate Soda	2 „
Bisulphite Soda	3 „
Water	1 gallon.

Dissolve the Cyanide of Potassium in 3 quarts of hot water, then add the Carbonate of Zinc, and when this is taken up add the Carbonate of Copper. Then dissolve in another vessel, in 1 quart of hot water, the Bicarbonate Soda and Bisulphite Soda. When the Solution is cold, add the two Solutions together, and well stir until they are thoroughly mixed.

Keep this Solution at a density of 12 to 15 on a Nickelometer ; if the Solution is hot, it should be used at 90° to 100° Fahr.

Directions for working Solution. If the deposit is red, add a small quantity of Liquid Ammonia, with or without a little Carbonate of Zinc mixed with it, or the current must be increased, or a small quantity of Carbonate Ammonia only will clear the Solution and alter the colour of the deposit. If the deposit is too pale, add some Carbonate of Copper mixed into a paste with Liquid Ammonia, or reduce the current.

If the Anode becomes dirty, having Oxide on it during working, and the deposit is pale and poor colour, it indicates a deficiency of Cyanide of Potassium, and a little should be dissolved in hot water and added. Or

if the Solution remains blue after stirring it, sufficient Cyanide of Potassium must be added to clear it.

If the Solution throws up a quantity of gas when working, and does not deposit any metal, that is an indication of too much Cyanide of Potassium in the Solution. Add some Carbonate of Copper and Zinc mixed with Ammonia until the deposit is obtained, the two former in the proportions given above.

The Solutions give better results by the addition of Brass Brights in very small quantities occasionally. Great care must be used in adding this; about 4 ozs. to 50 gallons of Solution is sufficient.

The Anodes and Connections must be kept clean, and the Anodes should be removed from the Vat every night after work is stopped, and placed in a Solution of Cyanide of Potassium 4 ozs., Water 1 gallon; this Solution will keep them clean and in good working order. If the Anodes are not clean in the morning, they must be scoured or dipped in Aqua Fortis before replacing. Cyanide of Potassium must be added from time to time to keep free Cyanide in the Solution.

The above Solutions will work well, giving quick deposit, with a pressure of 4 to 6 Volts across the terminals of the Vat.

Special Notes to be observed in working Cyanide of Brass or Copper Solutions. A frequent cause of failure is dirty Rods and Anodes. If at any time the deposit fails, see that both the above are clean before altering the Solution. Keep the Solution at one height in the Vat by the addition of water each day, as Solutions often get out of order by becoming too dense, caused by the evaporation of water.

One of the main causes of Brass and Copper Solution failing to work properly after it has been in use some time is on account of the Solution becoming too dense through the addition of too many chemicals. Keep the Solution at the density given, and if found too dense, take out some of the Solution, and fill up with water.

If the Dynamo is working properly and no current is going through the Bath, see that your Connections are properly screwed up, and be sure to see that your *Anodes* and *Rods* on *Vat* are clean; if not, take the Anodes out, either dip them in Nitric Acid or Aqua Fortis; or if no acid is at hand, scour them well in the Scouring Trough; also clean your Rods and Connections with emery cloth.

When work is finished at night remove the Anodes from the Vat, and place them in a Solution made with *Cyanide Potassium* 4 *ozs.*, *Water* 1 *gallon*. This will keep the Anodes in good working condition, and before replacing them in the Solution scour them well to free them from all Oxide formed on the surface.

Never put anything in the Solution till you have determined what is wrong.

If Hot Solution, always keep at one temperature.

Well examine the articles to be plated to see all the scale is removed.

For notes on Cleaning, and much information how to do the work properly, read the notes in chapter on Nickel-plating.

When your Anodes get black and an Oxide forms on the surface, the Solution requires the addition of some Cyanide of Potassium.

If the Anodes are clean and the Bath works slowly, the Solution requires the addition of some Copper or Zinc Salts, as the case may be; but always see that the current is flowing properly.

If articles, either Brass or Copper-plated, have stain spots on them, it is generally caused through the iron being porous. Great care must be taken to swill them when removed from the Vat, and allow them to remain in the clean swilling water some time; and if a Solution of Borax and water (2 ozs. Borax, 1 gallon water) is at hand, swill the articles in it; it will help to prevent the staining. If this does not remedy the staining, swill the article, then dry in sawdust, and allow the same to remain some hours; then either scratch-brush the article and replace in the bath for a short time, swill well, and dry out with sawdust, or, if the articles are small, swill through the Cyanide Dip to remove the stains; then place in the bath for a short time, as before described.

Stains are often caused when the Solution is thick and cloudy. It is then only possible by using a high voltage to drive the current through the solution; consequently a lot of gas is evolved, and causes staining of the work after it is removed from the Vat a few hours. If the Solution is in this state, allow it to settle for at least twelve hours, syphon off the clear Solution, care being used not to disturb the sediment at the bottom of the Vat; clean out the sediment, replace the clear Solution, and make up with new chemicals.

This staining occurs generally in cast-iron articles.

Large Articles. These are dried, after being plated, sometimes in a drying oven similar to a Gas Enamelling Stove (*See Catalogue No.* 709). The article is taken out of the bath and treated as before described, but put into oven in place of drying in the sawdust. This applies to large articles, such as large grates, gas stoves, and similar articles.

Never put chemicals, without being previously dissolved, into a Brass or Copper Solution. Have a certain amount of each chemical dissolved to a gallon of water ready for adding to the Solution.

Some articles which require plating very cheaply, such as Castor Horns, Window Fittings, etc., are often taken straight from the Polishing Shop, wired, and hung in the Brass or Copper Solution for a few minutes, taken out, swilled in hot water, and dried in the sawdust.

"Multibrass" Heavy Depositing Brass Solution.

For those articles requiring a heavy deposit of Brass, such as Motor-Car Fittings and Harness Furniture, equal to close plating, or a thickness of ·003 in., an ordinary Cyanide Brass Solution is useless. "Multibrass" Solution is most suitable for stamped or wrought iron articles which have a good surface, but is not recommended for castings unless previously nickelled.

If the following instructions are faithfully followed, a deposit can be obtained that will stand long wear and polishing:

Canning's "Multibrass" Salts	15 ozs.
Water	1 gallon.

Worked cold. Density, 8° to 9° on Canning's Nickelometer.

Instructions for Working "Multibrass" Solution.

To Make the Solution.

Vat. The Vat in which the Solution is placed should be perfectly clean, and made with wood, enamelled iron, or iron cement-lined.

Dissolving the Salts. To make the Solution the Salts must be dissolved in an earthenware or enamelled iron vessel, in hot water not exceeding 180° Fahr. (under no circumstances must the water boil). Fill the Vat intended for the Solution half full of cold water, and add the dissolved Salts through a Felt Filter Bag No. 288, and make up the right quantity of Solution with water.

Replenishing the Solution. To keep the Solution in order, four special Replenishing Salts are necessary—*i.e.*, A, B, C, D.

A. Replenish is necessary when the Anodes (which should be a grey-black colour, and not their natural colour) become black or show blue or white spots, or, again, if the deposit is reddish and the tint is not removable by rubbing with dry pumice, then ¾ oz. of Replenish A. should be added to every 10 gallons of Solution. The addition of the Replenishing Salts must be carefully made, until the Anodes attain the desired colour.

B. Copper Replenish is necessary when the deposit shows white patches, or the deposit becomes too pale, showing a bronze colour. Add 1½ ozs. of the B. Replenish gradually to every 10 gallons of Solution until the deposit is corrected.

C. Replenish is necessary when the work shows white patches and at the same time the Anodes show their natural colour. Add 1½ ozs. of the C. Replenish gradually to every 10 gallons of water until the correct deposit is obtained.

D. Zinc Replenish is necessary when the deposit becomes rough. Add ¾ oz. of D. Replenish very gradually to every 10 gallons of the Solution. The Replenish should also be added in the same way if the deposit shows a reddish colour on the surface, removable by rubbing with Pumice and showing underneath the proper green-yellow colour.

When Replenishing, care must be taken not to stir the whole of the Solution. The additions should be made in small quantities at different parts of the surface, and the top of the Solution gently stirred. The whole Bath should be thoroughly stirred occasionally, but work must not be put in till all sediment has had time to settle. It is advisable to stir each night after working.

All additions must consist of the necessary Salts dissolved (warm) in some of the Solution taken from the Bath. *No Solid Salts must be put into the Bath ; they must be completely dissolved.*

Anodes. Anodes should be of rolled Brass, suspended by Copper Hooks, and line each side of the Vat. The greater the Anode surface the better. The Anodes should not be left in the Bath overnight, but always removed when the Vat is not at work, and dipped in a strong Cyanide Solution (4 ozs. Cyanide Potassium to 1 gallon of water), then scoured with Powdered Pumice and swilled with water. They should be

kept immersed in a dilute Solution of Cyanide Potassium (1 oz. Cyanide Potassium to 1 gallon of water) until required.

Current. Current to commence 10 ampères per square foot super for 15 minutes should be used. This may be raised to 20 ampères per foot super, but should be lowered to 10 ampères during the last hour.

Voltage. This should be from 3½ to 5½ Volts. If a Voltage outside these limits has to be employed, the Bath is not in good order.

Preparation of Work for Vat. Cleaning the articles preparatory to plating is of the utmost importance. *Absolute cleanliness is necessary* to ensure good results. Place the article in a boiling Solution of "Zonax" Brand Brown Potash, or a Solution of "Lyco" for at least half an hour, then swill in clean water thoroughly, and if an Electrolytic Cleaning Vat is in use, pass through this, then well scour with Powdered Pumice, and swill in clean cold water. Before the articles are placed in the "Multibrass" Solution, give them a coat of Nickel in Nickel Solution for 30 to 45 minutes, then scour with Pumice Powder, and well swill before being put into the "Multibrass" Solution.

Deposit. If a thick deposit is required, after the article has been in the "Multibrass" Solution 20 minutes, take out, swill and scour with sand or scratch-brush the article, swill and replace in the Solution, and repeat this process about every hour.

Finishing. When the article is taken from the Bath it should be placed in running water and allowed to remain several hours, or it may be thoroughly washed and placed in a stove at a high temperature to prevent the appearance of black spots caused by the Cyanide Potassium. If no stove is available, immerse the article in boiling water for half an hour, then dry in hot boxwood sawdust. If the means just described do not prevent spotting out, the following method should be tried: Make Solution consisting of 1 lb. Bisulphite of Soda to 1 gallon of water, boil this Solution, and immerse the brassed article in it for 20 to 30 minutes; keep the Solution boiling. When the articles are removed, thoroughly swill in clean hot water and dry out in hot boxwood sawdust. The articles should then be stoved as before described.

Special Notes. Do not allow articles accidentally dropped in Vat to remain; remove them immediately.

Take care the article is perfectly clean before placing in Vat.

See that the electrical conditions are conducive to good results.

Well stir Solution at the end of each day's work, and keep it covered when not at work.

No solid substance should ever be added to Solution.

Swill all articles thoroughly. Never allow cleaning, Copper, or other Cyanide Solution to get into Vat.

"Spotting out" can be prevented generally by nickelling the article before Brassing.

BRONZE OR "TOMBAC" SOLUTION.

For producing a Bronze colour of a deeper shade than Brass, for Window Frames, Shop Fronts, and Iron Work for the interiors of buildings.

Canning's "Zonax" Copper Salts ..	9 ozs.
Canning's "Zonax" Zinc Salts	1¼ to 3 ozs. (according to shade required).
Water	1 gallon.

Dissolve the "Zonax" Copper Salts in the water, and add the "Zonax" Zinc Salts gradually till the required shade is obtained. Work the Solution cold at not below 65° Fahr. Work at 3 Volts for a distance of 6 ins. from Anodes to Cathode, and increase ½ Volt for every 2 ins. extra distance. Use pure Electrolytic Copper Anodes, or a Bronze Anode of 90% Copper and 10% Zinc. If an oxide forms on the Anodes when working, add carefully about ½ oz. Cyanide Potassium, "Zonax" Brand, 95% Grey, to each gallon of Solution, or more or less as required to keep the Anodes clean.

By changing the proportions of "Zonax" Copper and Zinc Salts, all shades of Bronze can be obtained from light brass to dark Tombac.

For *Iron Work* an addition of 2½ ozs. Bisulphite Soda and 1¼ ozs. Carbonate Soda to each gallon of Solution is an advantage.

SILVER-PLATING.

THE Vats used for Silver Solutions are either Wooden Vats lined with lead (*Catalogue, No.* 207), or Plain Iron (*Catalogue, No.* 212), or Enamelled Iron (*Catalogue, No.* 210). Articles of Brass, Copper, or German Silver, after being polished, as described on page 184, are wired up.

First Process. The articles are immersed for about 15 minutes in a cleaning Solution of "Lyco," or "Zonax" Brown Potash, to remove all grease and dirt (see article on Nickel-plating, p. 43). They are then taken out and well swilled in cold water (if Brass, they should be scoured with soft Scouring Powder in the Scouring Trough and well swilled in water).

The article is then dipped in Aqua Fortis and *quickly* swilled well in two or three lots of clean water. In places where Aqua Fortis is difficult to obtain, after the article is scoured it must be well scratch-brushed all over, then swilled. This process of scratch-brushing is to take the place of the Aqua Fortis dipping, but the Aqua Fortis dipping is recommended whenever possible.

Second Process. The articles now being cleaned and dipped in Aqua Fortis or scratch-brushed, are immersed in an Amalgamating Solution, composed of ½ to ¾ oz. "Zonax" Mercuric Salts, 1 gallon of Water, for a few seconds, until they show a whitish appearance; then well swilled in clean water and placed in the Silver Vat. To make a solution for amalgamating articles before silver-plating, dissolve ½ to ¾ oz. of "Zonax" Mercuric Salts to 1 gallon of Water. Add a little from time to time to strengthen the solution. If the article when dipped should be smoky, dilute the solution with water, the smoky appearance on the article can be removed by passing it through the Cleaning or Potash Solution. After they have been in the Silver Vat a few minutes and coated over, they are taken out, swilled, and

scratch-brushed, and immersed again in Amalgamating Solution; then swilled in clean water and put in the Silver Vat till the required thickness of deposit is obtained. Silver Solution is made as follows :—

For heavy deposits of Silver on Copper, Brass, German Silver, Iron previously Coppered or Brassed, and Britannia Metal :—

Canning's "Zonax" Silver Salts	8 ozs.
Boiled Water, cold	1 gallon.

Work Solution at 65° Fahr.

For Light Deposits of Silver on above Metals :—

Canning's "Zonax" Silver Salts	3½ ozs.
Boiled Water, cold	1 gallon.

Work Solution at 65° Fahr.

If an oxide is formed on the Anode, add a small quantity of Cyanide of Potassium "Zonax" Brand, 95% Grey (½ oz. to the gallon) dissolved in water. Great care must be used not to add too much.

Another Solution is made by using Cyanide Silver, the quantity of Cyanide of Silver depending on the strength of Solution required. Each ounce (avoirdupois) of Cyanide of Silver requires ¾ oz. (avoirdupois) of "Zonax" Cyanide of Potassium, 95% Grey, to dissolve it, and in addition to each gallon of Solution ¼ to ¾ oz. of Cyanide of Potassium extra for free Cyanide. To make the Solution, dissolve the "Zonax" Cyanide of Potassium in water, the proportion being ¾ oz. Cyanide of Potassium to 1 oz. Cyanide of Silver per gallon of Water. Then add the Cyanide of Silver, and when dissolved add a further quantity of Cyanide of Potassium for free Cyanide. The quantity of free Cyanide which needs to be added depends upon the purpose for which the Solution is to be used—that is to say, for light or heavy deposits—or, again, whether it is to be used for a striking Solution. It is better to add too little than too much, as the quantity can be increased gradually until the Solution is right.

The Solution is worked cold. A Solution containing more metal is recommended when articles require a very heavy deposit than when a lighter deposit is required.

A good surface of Pure Silver Anodes is required in the Vat.

Silver Salts will have to be added from time to time, to keep sufficient silver in the Solution.

Examine the articles after being in the Silver Vat a few minutes for the second time, and if the deposit appears good, allow them to remain; if, on the other hand, the deposit looks uneven or streaky, take the articles out, swill well in cold water, scratch-brush all over, swill again, immerse in Amalgamating Solution, swill well in clean water, and place in the Silver Vat till the desired thickness of deposit is obtained, take out, swill in cold water, scratch-brush all over, swill again, then immerse in hot water, and dry the articles in clean boxwood sawdust; they are then ready to be burnished or polished as desired.

Articles which are to receive a high polish and are not to be burnished must be polished bright before plating. They are then cleaned as before

described, in the Cleaning Vat, scoured well all over with a soft brush (and Scouring Powder for Brass), well swilled, then swilled through a solution of "Zonax" Cyanide of Potassium, made as follows : ½ lb. "Zonax" Cyanide of Potassium, 1 gallon of Water; then well swilled in clean water, immersed in the Amalgamating Solution, well swilled in clean water, and placed in the Silver Vat as before described. If a bright Silver Solution Vat is at hand, the articles should be put in for the last five or ten minutes. Articles which are polished bright before plating, and are finished on a mop, should not be scratch-brushed when removed from the Vat, but swilled, then dipped in hot water, and dried out in boxwood sawdust.

Articles made of Britannia Metal, Tin, Lead, or Pewter, are prepared for the Vat in a different way.

After the article is cleaned in "Zonax" Potash Solution, it should be immersed in a Solution as follows :—

Slack Lime is put into a tub or other suitable vessel, on which water is poured, and stirred up well, and then allowed to settle. This is what is known as "Lime Water." When the clear Solution is poured off, dissolve ½ lb. of "Zonax" Potash to 1 gallon of the Lime Water, and this Solution should be used hot. When the soft metal article has been cleaned, it is immersed in this Lime-Water-Potash Solution, and then put straight away into the Striking Silver Solution, and the article is struck.

This striking Solution contains a large quantity of free Cyanide of Potassium, and is made as follows:

To make 1 gallon :—

"Zonax" Silver Salts	1 oz.
"Zonax" Cyanide Potassium, 95% Grey ..	12 ozs.
Water	1 gallon.

Dissolve the "Zonax" Silver Salts in 1 pint of Water, and in a separate vessel dissolve the Cyanide Potassium in about 2 pints of Water. The Cyanide Potassium Solution should then be filtered, and the clear Solution added to the "Zonax" Silver Solution, and the whole volume made up to 1 gallon.

Four or six Volts are used. Allow the articles to remain in this special Vat of Striking Solution for a few minutes until they are coated all over; they are then taken out, well swilled in clean water, and scratch-brushed all over, then immersed in the Amalgamating Solution for a few seconds, well swilled in clean water, and put in the ordinary Silver Vat, till the desired thickness of deposit is obtained.

In establishments where a large quantity of Britannia Metal articles are plated, a different process is usually employed. When the article is wired, it is dipped in the Cleaning Solution, swilled, then scratch-brushed all over—this operation must be carried out very particularly—then swilled, and immersed in the Lime-Water-Potash Solution before being placed in the Striking Bath (the article is taken out of the Lime-Water-Potash Solution and put in the Striking Vat, whilst hot, without being swilled). After it is coated all over, it is taken out of the Striking Solution, swilled, and scratch-brushed. The process is again repeated through

the Hot Lime-Potash Solution, scratch-brushed again, and put in the ordinary Plating Vat till the desired thickness of deposit is obtained, then treated as before described.

Britannia Metal articles can also be Silver-plated by giving them a coat of Copper in the Cyanide of Copper Solution first (see article on Copper-plating), then Silver-plated, as described for Copper articles. For inexperienced operators this is the best method to adopt, also for replating Britannia Metal articles, when the old silver is removed, and the articles polished, a coat of Copper is first deposited, then Silver-plated, as described above.

Articles of Steel, after being cleaned, as described in chapter on Nickel-plating, are first coppered in a Cyanide of Copper Solution, prepared and plated as described in chapter on plating Brass or Copper articles; or they may be plated after being cleaned by putting them in the Striking Solution, as described in plating Britannia Metal, and the same instructions will apply.

Silver-plating Articles of Jewellery. An enamelled iron or earthenware vessel is used for holding the Solution (*See Catalogue, No.* 210).

Articles made of Brass, Copper, German Silver, or any base metal, when wired, if necessary are cleaned in the Cleaning Vat, then dipped bright in Aqua Fortis, or polished, and if greasy after polishing should be cleaned in the Cleaning Vat; they are then well swilled and immersed for a few seconds in a Solution of Cyanide of Potassium and water, as before described, then well swilled and put into the Silver-plating Solution till the desired thickness of deposit is obtained. The article is then swilled and dried in boxwood sawdust. In workshops where a large quantity of this work is done, it is usual to have the Silver-plating Solution heated for a second coat to about 150° to 180° Fahr. By heating the Solution a richer white deposit on the base of the article is obtained.

For a large number of articles only requiring a small quantity of Silver, they can be done in an earthenware Dipping Basket. To save the necessary wiring, some Copper Wire is threaded through the holes of the Basket, to which is connected the wire from the Dynamo or Battery. The Basket is held in the hand, and the articles are shaken about inside the Basket whilst in the Solution until the desired thickness of deposit is obtained.

Doctoring Silver-plating. Articles which have been plated and finished sometimes show defects in the deposit, generally on the edges where the deposit has been polished off, or where a small portion has stripped or peeled off. Where the defect appears, that part should be polished in the Polishing Shop and left nice and bright. It may then be doctored up and made good without replating the whole, in the following manner. Take a piece of Silver a few inches long and an inch or two wide, and place it between two pieces of wood, to form an Anode. Fasten a wire to one end of this Anode, and at the other end wrap some Calico or Flannel, several thicknesses, and tie securely. The article is then cleaned in the Cleaning Vat, swilled well in clean water—the part which requires doctoring should be scratch-brushed—and with the finger or a piece of rag previously dipped in the Amalgamating Solution, smear the place

where the Silver is off, then connect the Anode to the Anode Rod, and the article to the Cathode Rod of the Plating Vat, immerse the Anode in the Silver Solution for a minute or so to saturate the Calico, and rub the Anode backwards and forwards gently but smoothly over the faulty place; repeat the operation again and again until the thickness of the deposit is equal to that on the other part of the article. The Anode must be continually dipped in the Solution and be kept well saturated. In a few minutes sufficient metal should be deposited to stand burnishing or finishing, and if care is taken the faulty place should not be discernible. Use a strong current, 4 to 6 Volts.

Articles coated with other metals can also be made good in a similar manner.

In large Silver-plating establishments a Striking Solution and a Bright Solution are usually employed. The Striking Solution same as described in Silver-plating Britannia Metal is used. The article is immersed in the Amalgamating Solution, then swilled in clean water, and put in the Striking Vat for a few minutes till coated all over; again swilled and scratch-brushed, then immersed in the Amalgamating Solution, swilled, and put into the ordinary Silver-plating Vat. When the article has been in the ordinary Plating Vat till nearly the desired thickness is obtained, it is taken out and put direct into the Bright Silver-plating Vat for about 15 minutes, when the article may be taken out of the Solution, swilled well in cold, afterwards in hot water, and dried out in sawdust (sometimes the article is slightly scratch-brushed before being dried out), and is ready for burnishing or finishing as desired.

Bright Silver-plating Solution. The Silver Solution is made as described on page 102, with the following additions :—

Take about 3 pints of the Solution from the Vat and put in an earthenware jug, and add to this ½ pint of Bisulphide of Carbon and 4 ozs. of Cyanide of Potassium ("Zonax"). When the Cyanide is dissolved, put the contents into a bottle and shake up occasionally for two or three days; be careful when shaking up to loosen the cork or stopper of the bottle to prevent it bursting. This Solution should stand for a day or so to settle; then put 2 ozs. of the Clear Solution into a jug with ½ gallon of the ordinary Silver-plating Solution from the Vat, stir it up well, and distribute into the Silver Solution in the Vat; then stir up the whole Solution well right from the bottom of the Vat with a clean stick. It should be done over night, when the solution will have time to settle down ready for working in the morning. The operation of putting the Bright into the Vat may have to be repeated two or three times before the Solution begins to work bright. When the Solution once works bright, a little of the Brights will have to be added if the brightness of the deposit goes off. If possible, always add the Bright at night, stir well up, and it will be settled ready for working in the morning.

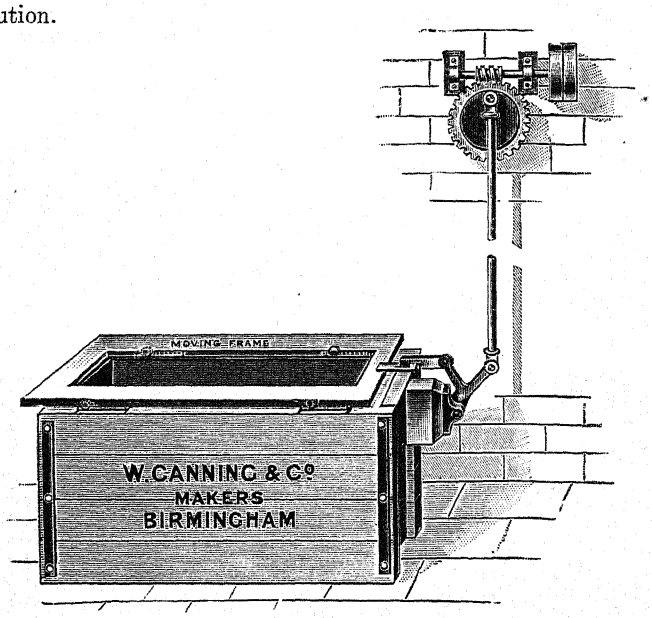
Note. It is important when adding Silver Brights that only the clear Solution be added, and none of the sediment from the bottom of the bottle.

One tablespoonful of the Silver Brights should be added to every

100 gallons of ordinary Silver-plating Solution, great care being taken not to add too much.

CATHODE MOVING APPARATUS.

In large plating establishments, where a large quantity of Silver-plating is done, the articles are moved in the Solution and a more uniform deposit is obtained. A framework of wood, the size of the top of the Vat, is made to travel backwards and forwards about 1½ inches; the motion is obtained from a Shaft, which has to be arranged according to the position of Vat and main shafting. The Cathode Rods rest on the moving frame, which moves across the Vat, allowing the Anodes to remain stationary in the solution.



Moving Apparatus for Top of Silver-plating Vat.

Re-plating Old Articles made of Brass, Copper, or German Silver. All the Silver on the article must be removed, either by stripping in Acid, polishing, or by a Special Silver Stripping Solution. The best process is that described on p. 207.

Another process used is the Acid Process, as follows :—

The article is wired and placed in Hot Sulphuric Acid, in which is dissolved 4 ozs. of Saltpetre to each gallon of Acid. The Acid, with the Saltpetre added, is put in an earthenware vessel; this vessel is placed inside another vessel containing water, and the water, upon becoming heated, heats the Acid. The article is then put in and moved about occasionally till all the Silver is removed; then swill well in two or three lots of clean water, scratch-brush it clean, swill again, and dry out in boxwood sawdust. The article is then ready for manipulation, and has to be polished and plated as before described.

Notes. If the Acid works slow, add some more Saltpetre.

The fumes from the Acid being very great, the stripping should never be done in the Plating Shop, but in the open air, if possible.

To get the Silver out of the Solution when the Acid will not take up any more, the latter is put into a large earthenware pan or wooden tub with three or four times its quantity of water. Dissolve some Carbonate of Soda in some more water, and add this Solution to the Acid Solution until it is neutralised by the Carbonate Soda Solution, when it will turn a Red Litmus Paper Blue. Some Hydrochloric Acid is then added to the Neutral Solution, and a precipitate is formed, which falls to the bottom of the vessel, when the clear liquid should be poured off. The precipitate is then dried, and it should be mixed with Universal Flux and fused in a Clay Crucible to obtain the Silver in a metallic state.

If the old Silver is removed by polishing, it is done as described in polishing articles of Brass, Copper, and German Silver. (See also article on Stripping Silver on p. 207.)

Britannia Metal articles are stripped in a Silver-plating Solution kept for the purpose. In a Vat is placed some Solution made in a similar way to Silver Solution for striking. The article from which the Silver has to be removed is used as an Anode, and a piece of Silver for the Cathode. When all the Silver is taken off, the article is taken from the Vat, well swilled, and dried out in boxwood dust, and is then ready for the polishing and plating.

Articles of Brass, Copper, German Silver, Iron, and Steel, can be stripped of their Silver equally as well as Britannia Metal by this process.

To recover Silver from Cyanide Solution, add some Hydrochloric Acid to the Solution, when a precipitate will be formed; pour off the Clean Solution, wash the precipitate, and let the same dry; when dry, mix with Universal Flux, put it in a Clay Crucible, and fuse to obtain the Silver in a metallic state.

Or another method is to evaporate the Solution, and fuse the bottoms in a crucible as before described.

Notes on Silver-plating. If the current is too strong, the article will have a dark brown appearance. Reduce the current at once.

If the Anodes are black or of a blackish appearance, add some Cyanide of Potassium to the Solution; but care must be used in adding this: do not add too much.

If the Anode is very white and appears powdery, it is an indication that Metallic Silver is required in the Solution, and should be added.

If the Silver deposit is slow and appears patchy it is often caused by the want of Metallic Silver in the Solution.

Articles which require a frosted appearance, such as clock faces, electrical instruments, cigar and cigarette cases, are sandblasted. See chapter on this subject (p. 138).

To ascertain the amount of Silver deposited on an article, the article must be weighed carefully before placing in the Silver Vat, and weighed again when finished; the amount of current used for depositing a given quantity of metal is given on p. 42.

Oxidised Silver or Silver-plated Articles. If the article is Silver-plated, the deposit must be heavy enough to withstand the action of the Oxidising Solution. Immerse the article in a solution of—

Hydrosulphide Ammonia, "Zonax" Brand	4 ozs.
Water	1 gallon.

Heat the solution to 180° Fahr. in an enamelled Iron Vessel.

Another solution is:

Sulphuret Potash, "Zonax" Brand	4 ozs.
Water	1 gallon.

Heat the Solution to about 150° Fahr. in an enamelled Iron Vessel. Leave the articles in the Solution till the desired colour is obtained, then swill in clean water, and dry out in clean boxwood sawdust.

If only a part of the article is required to be Oxidised, or the colour on the article is required shaded, the part which is required lighter than the other surface must be rubbed with some Calico and very fine Pumice Powder, or can be polished on a Calico Mop and Lustre Polish.

Another shade can be obtained which is a light blue grey:—

Bichloride Platinum	¼ oz.
Water	1 gallon.

Use the Solution boiling, and allow the article to remain in till the desired shade is obtained.

Antique Silver. After the Silver has been deposited on the article it is burnished or finished, a thin layer of Berlin Black, or Lamp Black mixed with a little Stopping-off Varnish and Turpentine (either of these), is rubbed over the surface of the article. The mixture is rubbed off the raised parts, and a thin layer is left on the remaining portion.

For further instructions on Oxidising Silver, see p. 223.

SILVERING BY IMMERSION, OR CHEAP SILVERING.

SMALL Brass and Copper articles, which are perfectly clean and bright, can be coated with Silver without current by dipping them in a Solution. In an earthenware or enamelled iron vessel make a Solution composed of—

Cyanide of Potassium (95% Grey), "Zonax" Brand ..	2 ozs.
"Zonax" Silver Salts	3½ oz.
Water	1 gallon.

The Solution is used at 100° to 120° Fahr. The articles, having been dipped or shaken bright, are put in an earthenware dipping basket and immersed in the Solution, shaking them about until all are coated, when they are swilled well, first in cold and then in hot water, and dried in boxwood sawdust. Cyanide of Potassium and Silver will have to be added from time to time as required.

Another solution which is used is as follows :—

Chloride of Silver	½ oz.
Cyanide of Potassium, pure	1½ ozs.
Water	1 gallon.

The above Solution is used cold, and will be called the Cold Solution.

Chloride of Silver	¼ oz.
Cyanide of Potassium	¾ ,,
Water	2 gallons.

This Solution is used hot, nearly boiling, and will be called the Hot Solution.

The articles being perfectly clean and bright, are placed in an earthenware Dipping Basket, then swilled through a weak Solution of Cyanide of Potassium 2 ozs., and Water 1 gallon; then swilled in clean water and immersed in the cold Solution for a few seconds till they are a milky-white colour. They are then immersed in the Hot Solution till they are a pure silvery-white colour. They are swilled through clean cold water, then through clean hot water, nearly boiling, then dried in clean boxwood sawdust.

In using this Solution care must be used that no Acid from dipping the articles is carried into the Solution; if so, a dirty, smoky colour will be the result. An excess of either Chloride of Silver or Cyanide of Potassium in the Solution will make the article come out a dirty smoky colour.

Great care must be used that the Hot Solution does not get too much Silver in it; the article being taken direct from the Cold Solution into the hot, it sometimes occurs that this is the case. The articles must be well shaken in the basket when immersed in the Solution, to prevent them coming out patchy.

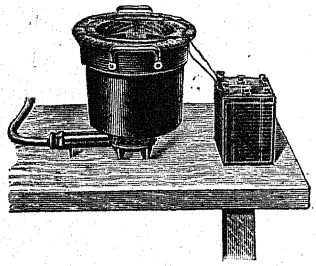
Keep the Hot Solution up to a level by adding clean water frequently. If the Hot Solution gets too strong of Silver, put some in the Cold Solution, and make up with water.

An enamelled iron boiler is recommended for this process. Small iron articles, such as hooks and eyes, buttons, etc., after being Electro-coppered or Brassed, are silvered in this Solution.

GILDING.

THE illustration on p. 111 is that of a Shop for Gilding or Silver-plating small articles, such as Jewellery. One side shows the Electric Motor driving the shafting which drives the Dynamo, the Lapping, Polishing, and Scratch-brushing Lathes. The Connection from the Dynamo to the Plating Stand is carried out as before described. The Solution is contained in the three round enamelled iron vessels, which are heated by gas, and alongside are the necessary cleaning vessels, the hot water, and sawdust, all of which are heated, and an earthenware sink for holding any earthenware dipping vessels, etc. On the other side of the Shop is the Scratch-

brush Lathe. In the other shop is the Lapping and necessary Polishing Lathes, as before stated. In fixing up a Plant for plating or polishing (if large or small) the same instructions apply.



An enamelled iron or earthenware vessel is used for holding the solution (*See Catalogue, No.* 211). Articles of Jewellery, after being wired, are dipped bright in Aqua Fortis, or if polished, and consequently greasy, they are put in the Cleaning Vat, then well swilled, and all articles immersed for a few minutes in a Solution of ½ lb. Cyanide of Potassium dissolved in 1 gallon of water; then swilled in cold water and scratch-brushed; then Gilt, well swilled, and scratch-brushed again, then lightly Gilt again. Care must be used when Gilding the article the second time to give it only just a film, so that it has a bright finished appearance, then swilled and dried out in boxwood sawdust.

Articles with soft solder on them, or base metals, are Coppered in a Cyanide of Copper Solution (see p. 91), well scratch-brushed, and Coppered two or three times, and the article should be Gilt as soon as possible after being Coppered.

The Solution we make for Gilding (*See Catalogue, No.* 143) is one which we can recommend with every confidence. Work the Solution from 120° to 200° Fahr., according to the shade of colour required. A Gold Anode should be used, and the Voltage should be from 2 to 6 Volts across the terminals of the vessel.

Large articles of Brass and Copper are Gilt in a similar manner; articles of Iron and Steel must first have a deposit of Brass or Copper before being Gilt.

Gold Solution for Heavy Deposits:—

Canning's "Zonax" Gold Salts (40% Fine Gold) ..	1 oz.
Water	1 gallon.

Work Solution at 120° to 140° Fahr.

For Light Deposits:—

Canning's "Zonax" Gold Salts (40% Fine Gold) ..	½ oz.
Water	1 gallon.

Work Solution at a temperature of 120° to 140° Fahr. An addition of Sodium Phosphate 1½ ozs., and Potassium Cyanide, "Zonax" Brand, 95% Grey, ¾ oz., per gallon of Gold Solution is advisable if a clearer colour is required.

We recommend Anodes of pure Gold, although Platinum and Carbon Anodes can be used. If Gold Anodes are not used, the Gold is necessarily taken from the Solution much more rapidly.

Should the Gold Anode turn to a dark discoloration while working, Cyanide of Potassium, "Zonax" Brand, must be added carefully in small quantities.

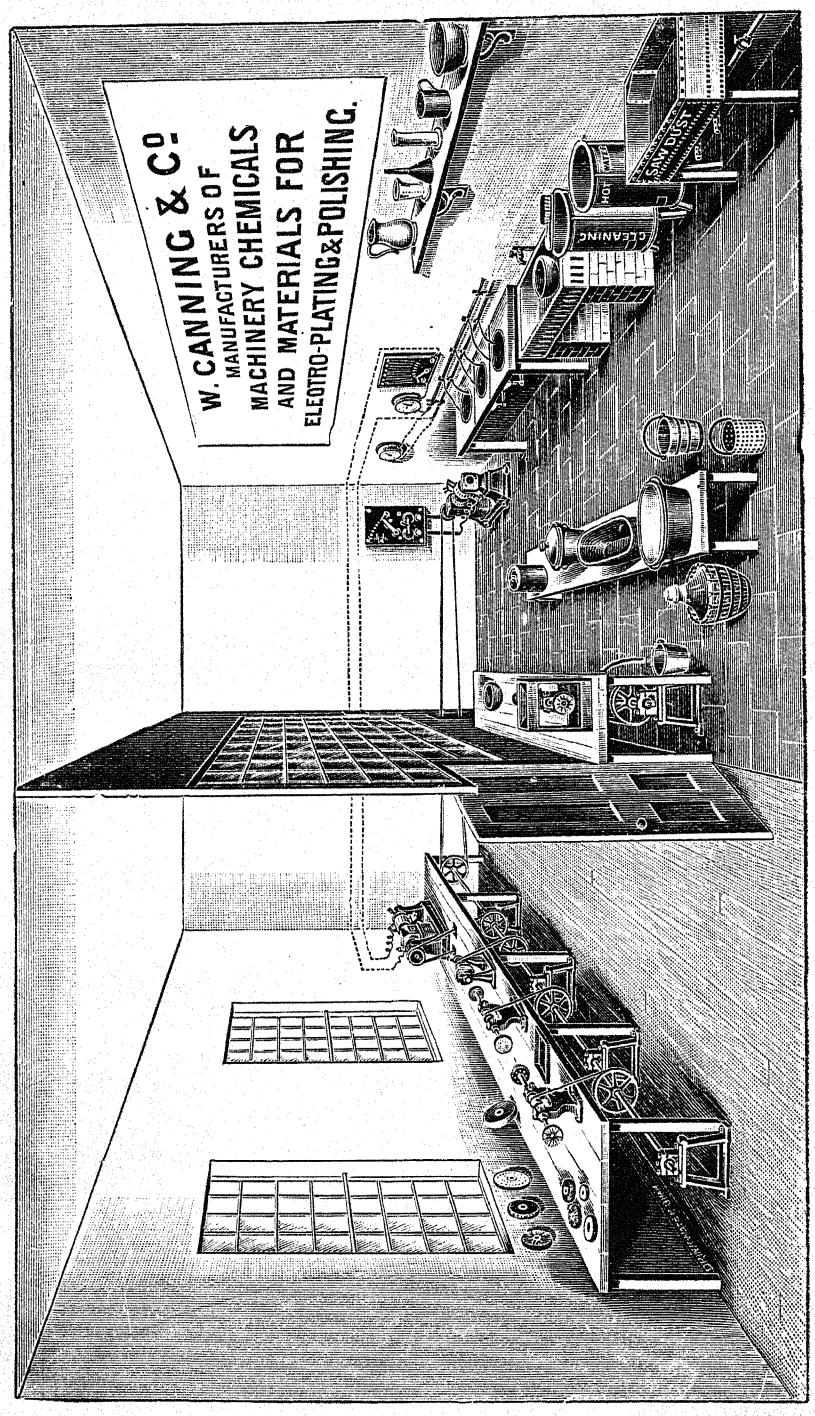


Illustration of Gilding and Polishing Shops for Jewellery Manufacturing.

Work Solutions at about 3 Volts; higher Voltages give darker shades, and lower Voltages lighter shades.

Combinations of Gold, Silver, and Copper "Zonax" Salts give variations of colour. By addition of Copper "Zonax" Salts to the Gold Solution, according to different proportions, any kind of red gold can be obtained. By the additions of Silver "Zonax" Salts to the Gold Solution all kinds of green gold can be obtained, and by additions of Silver "Zonax" Salts and Copper "Zonax" Salts to the Gold Solution a pink colour can be obtained.

Notes on Gilding to be Observed. If the article is red, too much current is passing; raise the Anode a little out of the Solution and keep the article moving in the Solution.

If no Gold is being deposited, look to the Connections, and see that the current is flowing, especially if dry batteries are used.

If too much Free Cyanide of Potassium is in the Solution, the colour of the deposit will be patchy.

If the Solution works slow, add some Cyanide of Potassium, but only a few grains at a time to a gallon of Solution.

If the deposit is red, patchy, and works slowly, the Solution requires the addition of Metallic Gold.

If a very pale-coloured deposit is required, mix a little Silver Solution with the Gold, and keep the Solution specially for this colour. If a red-coloured deposit is required, add some Cyanide of Copper Solution to the Gold, and keep it for this special colour.

Gilding Articles Inside. Articles which require Gilding inside, such as Sugar Basins, Salt Cellars, Cream Jugs, Spoons, Jugs, Presentation Cups, etc., and require a bright surface when finished, are finished or burnished first, then swilled through the Cleaning Vat to remove any grease, dirt, etc., then swilled through the Cyanide of Potassium Solution They are then ready to receive the Gilding Solution.

Large articles, such as Cups, Sugar Basins, etc., are filled with Gold Solution and connected to the Cathode Rod; a piece of Gold wrapped in two or three pieces of calico with a wire attached is connected to the Anode Rod; the Anode is suspended in the Solution inside the article, and moved about briskly for a short time, which, of course, depends upon the thickness of deposit required. If the edges of the articles are required to be Gilt, the Anode is rubbed on the part required in a manner similar to "Doctoring," described in Silver-plating. The Solution is then replaced in the vessel from which it was taken, the article is swilled, immersed in hot water, and dried out in boxwood sawdust. If the article is not bright, it must be scratch-brushed after being swilled, and before being dried in sawdust.

Cigar and Cigarette Cases, Egg Cups, Spoons, etc., after being cleaned, are treated in a similar manner, but it is often convenient to use a pair of pliers for holding the articles with the Cathode Wire attached.

If the article requires a frosted appearance, it is sandblasted (see p. 138) or frosted on a brush (see p. 133); the article, after being cleaned, is sandblasted, then scratch-brushed, gilt, and scratch-brushed again.

The Solution should be used at 120° to 200° Fahr., according to the colour required. Voltage required for inside Gilding, 4 to 6 Volts.

The articles should be held over an earthenware dish, such as illustrated in *Catalogue, No.* 315; then, if any Solution is spilt, it is not wasted.

If the Gilding creeps or the Gold is deposited in places round the edge where it is not required, it must be removed by polishing on the lathe with a soft mop and dry rouge.

GILDING BY IMMERSION.

Canning's "Zonax" Gold Salts (40% Fine Gold) ..	½ oz.
Canning's "Zonax" Cyanide Potassium	½ oz.
Water	1 gallon.

Solution must be heated to nearly boiling point—viz., 180° to 212° Fahr.

Articles must be clean as for Electro-Gilding.

PARCEL-PLATING.

Plating Articles in Two or Three Colours. This is done by stopping off the part of the article which does not require to be plated. For example, take a Copper Plaque, some part to be left Copper colour and the other Silver; the part which requires to be left Copper is varnished with Stopping Off Varnish (*See Catalogue, No.* 190). When thoroughly dry (heating the article a little will hasten it) the article is cleaned and put in the Silver Vat until the desired thickness of deposit is obtained; it is then swilled and dried out in sawdust in the usual way. When thoroughly dry it is placed in Turpentine till the Varnish is softened and can be brushed off with a bristle-brush; the article is then put in the Cleaning Vat for a short time, well cleaned and swilled, then dried out in sawdust. It is then ready for burnishing or finishing as desired.

Articles of jewellery are done in a similar manner—viz., if gold flowers are required on a silver brooch, the part which does not require to appear gold is stopped off and treated as described above.

TIN-PLATING.

A PLAIN Iron Vat with a wooden frame on top is used for this purpose. Articles of Iron or Steel are cleaned in a similar manner to that described in Nickel-plating.

Small articles, such as Hooks and Eyes, Pins, Fish-hooks, and similar articles, which are generally polished in a Shaking-barrel, and are free from grease and dirt, are put straight into the Solution, dispensing with the cleaning process. The small articles are placed in wooden baskets. They must be frequently taken out of the Solution, and the articles turned over and over to bring those lying in the centre to the outside; a three-pronged fork is used for this purpose. They can also be plated in a Barrel (see p. 64).

A good deposit can be obtained in 30 minutes. When the articles are taken from the Solution they are swilled well, dried in clean hot sawdust, then placed with some bran in a wooden barrel and revolved *till bright* (see pp. 87, 199).

A Barrel (*Catalogue, No.* 411) is used for this purpose. The bran should be free from all particles of flour, otherwise the latter will stick to the articles.

Large articles are first pickled and scratch-brushed, as described in Brass- and Copper-plating, then wired and placed in the Tin Solution for about 30 minutes; afterwards swill, and dry out in sawdust. If a bright, silver-like appearance is required, the article is scratch-brushed after plating, then swilled, and dried out in sawdust.

To make the Solution:—

Tin Solvent	8 ozs.
Tin Salts	2 ozs.
Cyanide Potassium	½ oz.
Bitartrate Potash	1 oz.
Water	1 gallon.

(The Solution to be used at a temperature of 180° Fahr.)

The density of this Solution, when newly made, registers 4 to 5 on a Nickelometer. It soon increases in density, but cannot be worked satisfactorily if it exceeds 10. This Solution occasionally requires filtering, or run through muslin sheets. Keep the Solution as clear as possible.

Dissolve the Tin Solvent in the water, and then add the Tin Salts and other chemicals. If a large quantity of Solution is required, put the Solvent in a canvas or calico bag and hang in the water till all is dissolved; then, in another bag, dissolve the Tin Salts and other chemicals in the same way, and well stir the Solution.

The Vat must be well lined with pure Grain Tin Anodes; if the Anodes become coated with a black Oxide, add more Solvent to the Solution; or the voltage passing into the Vat is too high, and must be reduced; if the Solution is cloudy, add more Solvent; if the bath works slow, add some Salts.

If the deposit is spongy and rubs off, this is an indication that the voltage is too high, or the Solution requires the addition of some Tin Salts.

Voltage at the terminals of the Vat, 4 to 6 Volts.

When the Solution is thick and cloudy and works slowly, it indicates the Solution is too dense. It should be allowed to cool for at least twelve hours, then the clear Solution syphoned off, the sediment removed from the bottom of the Vat, the clear Solution put back into the Vat and made up with new. It is very difficult to work a Tin Solution when it becomes thick.

Keep the Solution at 6 to 7 on a Nickelometer. If it becomes too dense, some of the Solution must be taken out, and the Vat made up with the addition of water.

Tin Solution. Always have some Tin Solvent dissolved ready for putting into the Vat. Dissolve the Solvent (½ lb. to a gallon of water), stir up well, and allow the Solution to settle, using only the clear Solution

for putting into the Vat. The insoluble part which settles at the bottom should not be put into the Tinning Solution.

Keep the Solution up to its proper height in the Vat by the addition of clean water each day.

CANNING'S "ARTAX" HEAVY DEPOSITING COLD TIN SOLUTION.

FROM this Solution a very thick deposit of Tin can be obtained. For some purposes the deposit from this Solution is more satisfactory than coating the articles by the Molten Process, as a smooth deposit of tin is obtained, free from lumps or disfigurements to the articles when finished. The thickness of the deposit depends on the time the article is left in the Solution.

It is specially worth considering where a screw thread is on the article. The same efficiency is obtained, with economy in Tin, as compared with the Molten Process, so that with the ever rising price of Tin this Electro Process commands the consideration of manufacturers.

Instructions for Working.

Condition of Vat. The Vat in which the Solution is placed should be perfectly clean and made with enamelled iron or plain iron.

Dissolving the Salts. Dissolve the Tin Solvent in hot water, and add Tin Salts to the Solution. When these are dissolved, add the Regenerating Fluid to the Solution, well stirring. It is most important that the Regenerating Fluid is added to the Solution of Solvent and Tin Salts, and the density of the Solution should be 12° to 14° on Canning's Nickelometer.

Temperature of Solution. The temperature of the Solution should not be less than 60° Fahr.

Current. This will follow the Voltage, and when the Bath is in good order too much current is indicated by the deposit becoming spongy and streaky.

Voltage. One-fifth to two-fifths of a Volt is the correct Voltage when the article being plated is about 7 ins. from the Anodes. A Voltmeter should always be used when working this Solution. The Voltage is the most important guide. If a good deposit is not obtained at the Voltage given above, then there is something wrong with the Solution. The article should be struck at about ½ Volt, and as soon as covered the Voltage should be reduced to that stated above.

Anodes. The Anode should be of pure Cast Tin, and the Anode surface should be from 1½ to 2 times the surface of the articles being plated.

The Anodes will become covered with a dark greyish coloured film, which should be removed by scouring with sand when the Anodes are taken from the Solution at night.

Working and Replenishing the Solution. If the deposit is spongy when the current conditions are correct, this is evidence that the Solution contains too little free solvent. Add Tin Solvent in the proportion of 1 oz. to every 5 gallons of Solution until the deposit is smooth.

If the deposit is slow and the Anodes are crystalline in appearance, this indicates too much free Solvent in the Solution. Tin Salts must be added in the proportion of 1 oz. to 5 gallons of Solution.

If the deposit is crystalline while the proper current conditions are maintained, and the Anodes are of a dark grey colour, this indicates that the Regenerating Fluid is needed, and this should be added in the proportion of 4 fluid ozs. to every 10 gallons of Solution.

In every case when the Salts are added to the Solution, the Salts to be added should be dissolved in some of the Solution taken from the Vat, and this Solution, when the Salts are dissolved, put back into the Bath through a filter.

If a deposit of more than one-thousandth part of an inch is required, the article should be scratch-brushed after being in the Solution for 20 to 30 minutes, then swilled in clean running water, and replaced in the Vat. After a sufficient deposit has been obtained, the article should be removed from the Vat, swilled in clean, cold, running water, then in clean, hot water, and dried in hot boxwood sawdust. If a bright, silver-like appearance is required, scratchbrush after plating.

Preparation of Work. The articles must be thoroughly freed from grease, rust, and dirt in the usual way, and it is an advantage to scratch-brush them if a very heavy deposit is required.

Special Notes. Do not allow articles accidentally dropped in the Vat to remain; remove them immediately.

See that the article is perfectly clean before placing in the Vat.

See that the electrical conditions are conducive to good results and a suitable resistance is employed.

No solid substance should ever be added to the Solution.

No chemicals, other than those given in these instructions, must be added to the Solution.

TINNING BY IMMERSION, OR BOILING WHITE.

SMALL Brass or Copper articles, which are perfectly clean and bright, can be coated with Tin by boiling them in a Solution. In a copper vessel put 4 ozs. of Cream of Tartar and 1 gallon of Water. Tin must be mixed with the articles in the shape of grains, and the articles can be placed loose in the pan and stirred occasionally with a stick, or put in a canvas bag along with the Tin, and occasionally shaken during the boiling process to alter the position of the articles. When they are thoroughly covered they are swilled in clean hot water, and dried in boxwood sawdust, and, if necessary, polished in a wooden Shaking-barrel, with dry, clean boxwood sawdust.

To make the flakes of Tin, melt some pure Tin in a ladle, and allow it to drop into a pan of water, pouring it very slowly. Allow the fall to be about 2 or 3 feet between the ladle and the water.

The Solution will require the addition of Cream of Tartar from time to time.

THICK COPPER DEPOSITING.

A WOODEN Vat lined with lead is used for this purpose. The use of the Dynamo is most essential to this work, although Batteries can be used for small quantities of work where no power to run the Dynamo is available.

Anodes. These should be Pure Copper, free from all impurities.

Solution :—

Pure Sulphate of Copper	2 lbs. 2 ozs.
Sulphuric Acid	5 fluid ozs.
Water	1 gallon.

Density when cold 19° on Canning's Nickelometer.

Dissolve the Sulphate of Copper in warm water in a wooden or earthenware vessel, then add the Sulphuric Acid, used cold, not below 60° Fahr.

If Batteries are used, they should be connected up in parallel—*i.e.*, all the Carbons together and all the Zincs together.

Articles of Steel, Iron, or Zinc, which are to receive a thick deposit of Copper in the Acid Solution, must first of all be coated in the Cyanide of Copper Vat, and the instructions given on p. 91 will apply. The articles should be left in the Cyanide of Copper Vat 10 to 15 minutes ; when taken out, well swilled, and scoured with Scouring Powder for Iron, then placed in the Acid Copper Solution Vat. After the article has been in the latter Solution about 15 minutes it should be examined, to see if it has any dark patches or spots ; if it has such marks it must be taken out of the Vat, swilled well, scoured or scratch-brushed over the faulty part, and then receive another coating in the Cyanide of Copper Solution Vat, exactly as before described. The colour of the deposit should be a rich reddish-yellow colour ; a dark brown deposit usually indicates a spongy deposit, and the current must be reduced. If the deposit is a very pale colour, it usually indicates that the current is too weak. In some cases, when the articles are not flat and a very thick deposit is required, some mechanical power has to be employed to move the article in the Solution, so that every part of the article has the same thickness of deposit. If it is required that any portion of the article should not receive the deposit, it must be painted with a mixture of Pure Bees'-wax, 1 lb. ; Boiled Linseed Oil, 2 ozs. Melt the Wax in a suitable vessel, then add the Oil, and mix well. Paint the part which is not to have the deposit several times whilst the mixture is hot, allowing the mixture to set on the article between each coat.

Articles coated with Wax must always be deposited in a Cold Cyanide Copper Solution.

To remove the Wax Mixture when the deposit is finished, warm the article and let the mixture drop into a suitable vessel. The mixture may be used several times.

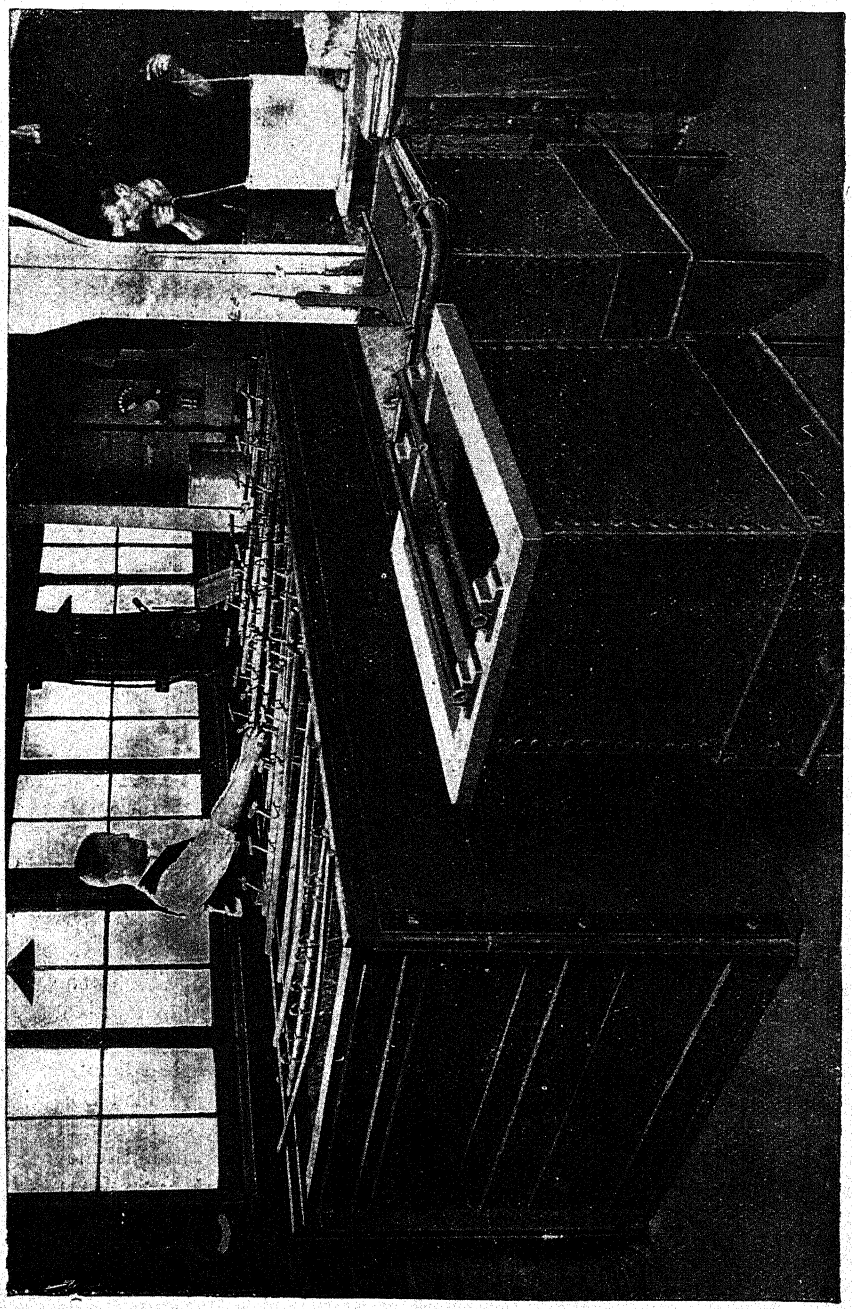


ILLUSTRATION OF LONDON STEREO NICKEL FACING PLANT.

ELECTROTYPING.

Depositing Copper for Printers' Blocks, Type, etc. A composition is used made as follows :—

Pure Beeswax	16 ozs.
Venice Turpentine	1 oz.
Plumbago	¼ oz.

The Venice Turpentine is only used when the Beeswax requires it.

Melt the above in a suitable vessel—a steam jacketed kettle for preference.

Great care must be exercised in the boiling to prevent the composition being burnt.

If the composition is too soft, it is necessary to add a little Burgundy Pitch, but very sparingly. To ensure the composition being perfectly mixed, it is advisable to re-melt several times before using.

A moulding box or case must now be prepared. This may be accomplished by taking a sheet of stereo or Backing Metal about a Pica thick, and laying it on a metal-top table perfectly flat. Pieces of square iron bar should then be arranged round the sheet to form sides, so that it can be filled with composition to the thickness of about ¼ inch. The metal plate should be heated before pouring on the composition ; this makes it adhere much better.

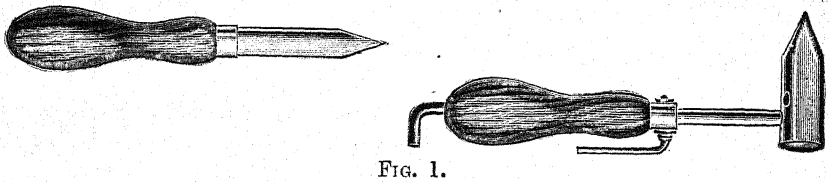


Fig. 1.

When set, the iron bars may be removed, and the wax case trimmed.

This case is now carefully dusted over with Plumbago with a badger-hair brush, the forme or blocks being treated in the same way to prevent them sticking to the mould.

The forme is now placed on a Hydraulic or Toggle Press, the wax case placed on the top, and an even pressure applied. The proper amount of Pressure or "Squeeze" can only be arrived at by experience. When sufficient depth has been obtained on the mould, it is taken off and examined to see if it is right ; the wax that has been forced round the sides of the mould is then cut away.

Any blanks or wide spaces should be risen or built up by means of melted wax from a strip with a heated copper poker (similar to a soldering iron, Fig. 1), and running it on to the mould. This gives sufficient depth to prevent blacking up on the machine when printing.

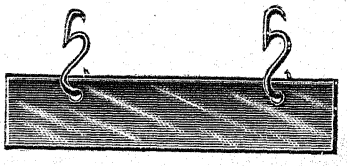


Fig. 2.

The next operation is to prepare the mould for the depositing Bath. A connection is made by heating a flat piece of copper (Fig. 2) about

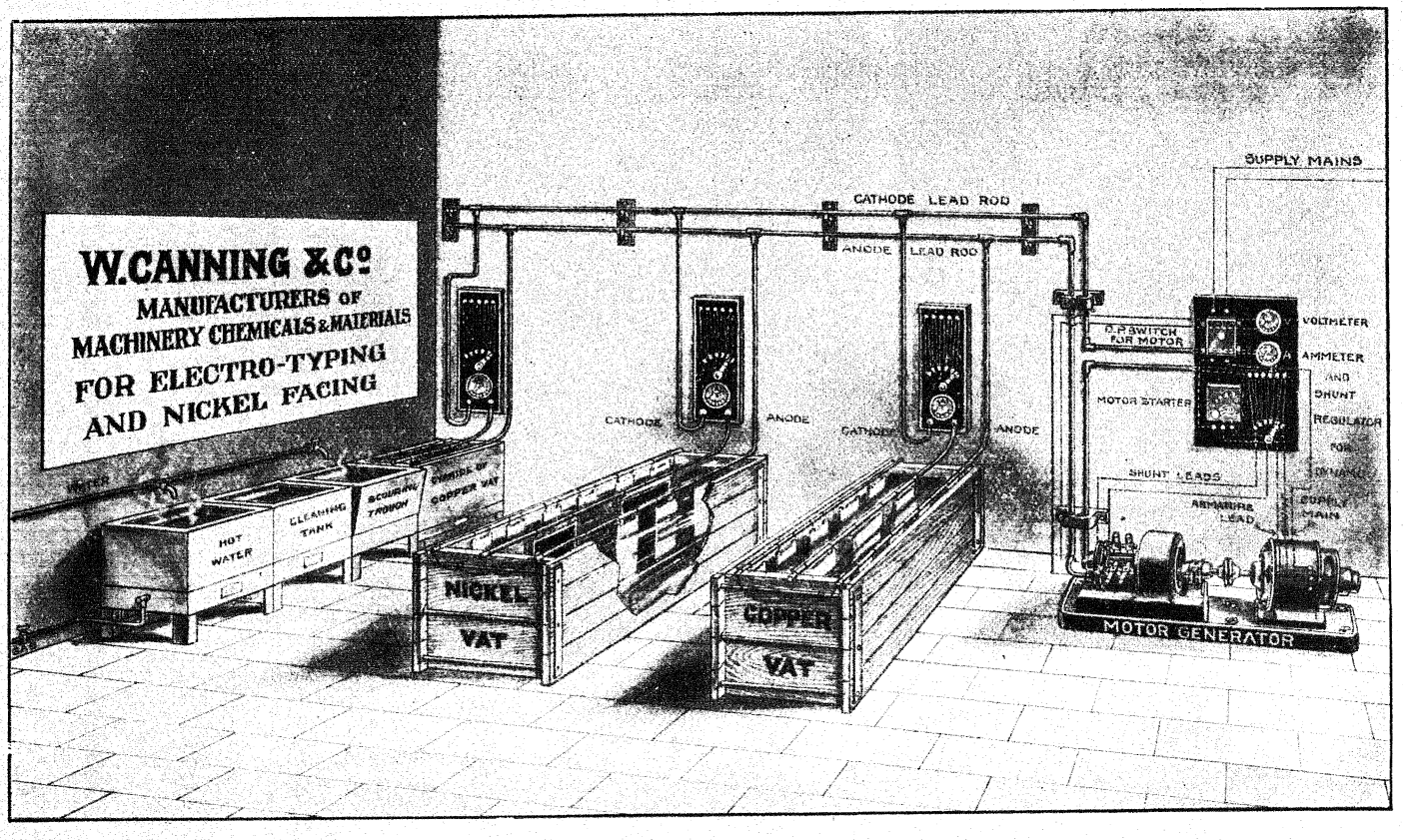
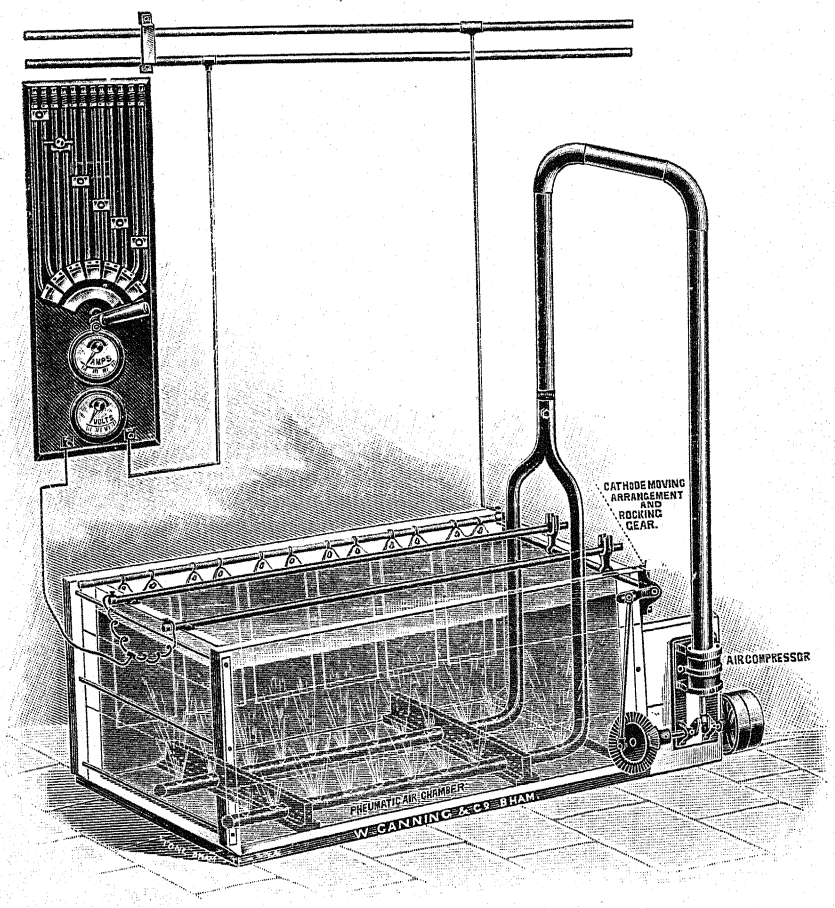


ILLUSTRATION OF NICKEL FACING PLANT.

6 inches wide, and sticking into the wax, taking care that it does not come into contact with the metal of the case, otherwise, when placed in the depositing Vat, there will be a deposit on the back as well as the front of the mould. The wax mould is now very carefully prepared as follows :—

A quantity of Plumbago is sprinkled on the face of the mould, and well brushed into *all the recesses*, especially if typed work is being operated on, otherwise the copper shell will not grow perfect. This



CANNING'S PATENT PNEUMATIC AGITATOR.

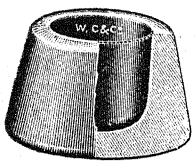
is a most important operation, as any part missed will cause a defective deposit. The mould should be cold before applying the Plumbago to prevent damaging fine work. The mould is now burnt round with a hot iron to remove the Plumbago from any part not requiring a deposit of copper ; it is then well washed with a strong stream of clean cold water to remove all loose Plumbago, and also to thoroughly wet the surface of the mould, thus preventing air-bubbles forming on the surface. The

copper connections are now cleaned to remove any wax from that part which hangs on the rod; the mould is then suspended in the Bath from the Cathode Rod directly opposite to a copper Anode about 3 inches apart

If shells are required in a very short space of time, it is customary to chemically deposit copper on the mould before being placed in the Bath. This operation is carried out as follows :—

After the mould has been well swilled, a quantity of Sulphate Copper Solution (specific gravity, 12° Beaume) is poured on the face; fine iron filings are then sprinkled on the Solution, and with a fine brush the iron is caused to fall on the face of the mould. As soon as the iron is covered with the Solution it reacts, and the copper from the Solution is precipitated on to the face of the mould.

All filings must be thoroughly washed out of the mould with a strong stream of water before hanging in the depositing Bath. A mould treated in this way covers very rapidly, thus saving a lot of time, also allowing



SOLDERING "TOT."

of a much greater current to be put on the mould immediately after hanging in the Bath.

For rapid deposition, it is necessary to have an agitator (see p. 121); by this means the Solution is always of an even density, thus preventing burning (as it is commonly called) or porous copper.

The Solution temperature should be 70° to 75° Fahr., or 21° to 24° C.

A good commercial shell can be deposited in 20 to 40 minutes with a Pneumatic Agitator fitted in the Bath.

When the shell is of sufficient thickness, the mould is removed from the Bath, washed with clean cold water to remove any Solution. Boiling water is then poured over the shell, the shell at the same time being lifted from the wax.

Care must be taken not to drag the shell off, as it is liable to buckle and cause trouble in the backing-up.

Always use boiling water to remove the shell from the wax.

The shell is now trimmed round and cleaned in a Solution of Canning's "Lyco" (see p. 46), afterwards washed with clean water. The back of the deposit is painted over with Tinning Solution; it is

then placed on an Iron Tray face down (Fig. 3), and Tin Lead Foil is spread over the shell; the tray is laid on the top of the hot Metal Pot until the foil is just melted. It is then removed to a level stand or table, and backing metal (see p. 125) poured over the surface of the shell until a depth of $\frac{1}{4}$ inch is attained. The metal must be poured on sufficiently hot to flow easily over the whole surface from one corner of the shell.

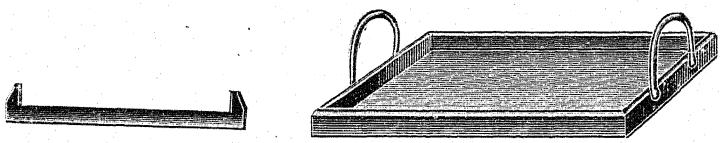


FIG. 3.

When the metal has set, the plate is removed from the tray and washed over, then carefully examined for defects.

The edges must be trimmed, and the plate cut up to convenient sizes for levelling (if more than one job is in the plate). Should there be any sinks on the face, they are removed by marking the exact position on the back of the plate with calipers (Fig. 4), turning the plate face down on an absolutely flat and smooth steel slab (finisher's slab), then tapping very lightly with finishing hammer on the plate where marked. After the sinks are removed, the plate should be levelled to a steel straight-edge. The plate is now ready for turning to the required thickness for mounting on wood or catch blocks; if for the latter, the edges should be bevelled. When the edges are trimmed, the plates should be carefully examined to make certain there are no defects, a proof taken, and then passed on for printing.

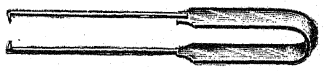


FIG. 4.

For the reproduction of articles such as Medals, Coins, Plaques, Panels, and articles which are undercut, a Composition is used as follows:—

Gutta Percha	2 lbs. best quality.
Lard	1 lb.
Linseed Oil	$\frac{1}{2}$ oz.

Melt all together and thoroughly mix.

The Composition. This may be used either fluid or in a plastic state. If the Fluid Composition is used, the article must be brushed well with Plumbago, to prevent it adhering, the article being placed on a level iron tray with a metallic circle round it, slightly deeper than itself. The Fluid Composition is poured slowly on to the centre, and allowed to flow gently over the whole surface of the article to be reproduced, where it should remain until the composition is completely set. The composition, being divided from the article, is well brushed with Plumbago, or Copper Bronze Powder mixed with thin Spirit Varnish is painted on the surface. Copper Wire is embedded as described in Electrotyping, and the Composition Mould is placed in the Solution till the desired thickness of deposit is obtained.

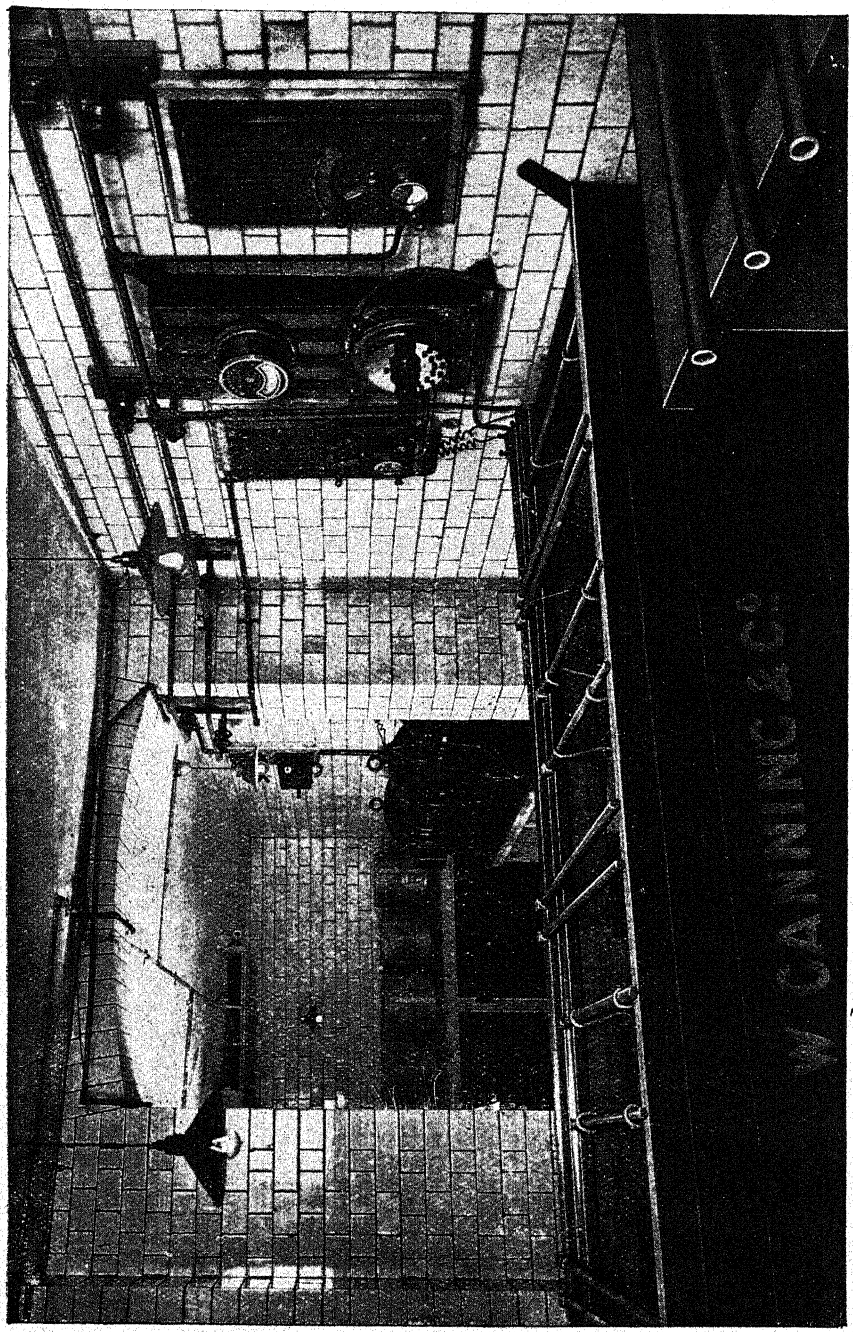


ILLUSTRATION OF NICKEL FACING SHOP OF A LONDON PRINTING ESTABLISHMENT.

The composition may be used in a plastic state. Warm it till it can be moulded easily; then press itfirmly on the article, commencing in the centre, until the whole is covered; then allow the whole to cool under a gentle and even pressure. To prepare for the Vat, carry out as before described.

Copper Depositing on Engraved Copper and Steel-Plates. Care must be taken to prevent the deposit adhering when a Copper-plate is to be Electrotyped. The surface of the plate should be rubbed over with Turpentine in which is dissolved a very small quantity of Beeswax. Care must be used to only give a film, as when the spirit evaporates only a mere trace of Wax should remain. The back of the plate is varnished with Stopping Off Varnish to prevent the Copper depositing. The connection may be soldered to the back of the plate, or held in a suitable frame.

Copper and Steel plates can be reproduced by moulding them in the Gutta Percha Composition, as before described.

Notes to be Observed on Electrotyping. If the Solution is stationary, stir every night; it will then have time to settle and be ready for use in the morning.

Absolute cleanliness must be observed throughout the process.

The depositing room must be kept at an even, warm temperature.

To keep the Solution in good condition, hang a bag of Sulphate of Copper in the Vat.

When the Solution is once made, it should not require any addition of Acid. If too much Acid is in the Solution, the deposit is brittle. To remedy this, add some Carbonate of Copper.

The use of Accumulators for this work is recommended, as a constant and unvarying current can then be obtained.

Further information on Electrotyping and thick Copper Depositing can be obtained from one of the text-books enumerated at the end of this book.

Remember, the *articles* to be brushed with Plumbago require a Badger or Goat-Hair Brush to obtain a bright, black, polished surface.

Backing Metal is made with 6 parts of Antimony, 92 parts of Lead, and 2 parts of Tin.

Engraved Copper-plates are often faced with a coat of Nickel or Steel, in order that a greater degree of hardness of the surface may enable the printer to obtain a greater number of sharp impressions from the same plate.

To Nickel the surface of a Copper-plate, the plate is cleaned in the Lyco Solution, then scoured with a Soft Brush and Scouring Powder for Brass, and Nickel-plated, as instructed in chapter on Nickel-plating.

STEEL FACING.

To Steel the surface of a Copper-plate, the plate is cleaned and scoured as described previously.

A Lead-lined Wooden Vat is used, and the Solution is made as follows:—

Ammonium Ferrous Sulphate (Sulphate of Iron and Ammonia)	1¾ lbs.
Water	1 gallon.

Dissolve the Sulphate of Iron and Ammonia in an earthenware vessel in the proportions given. Use the Solution cold.

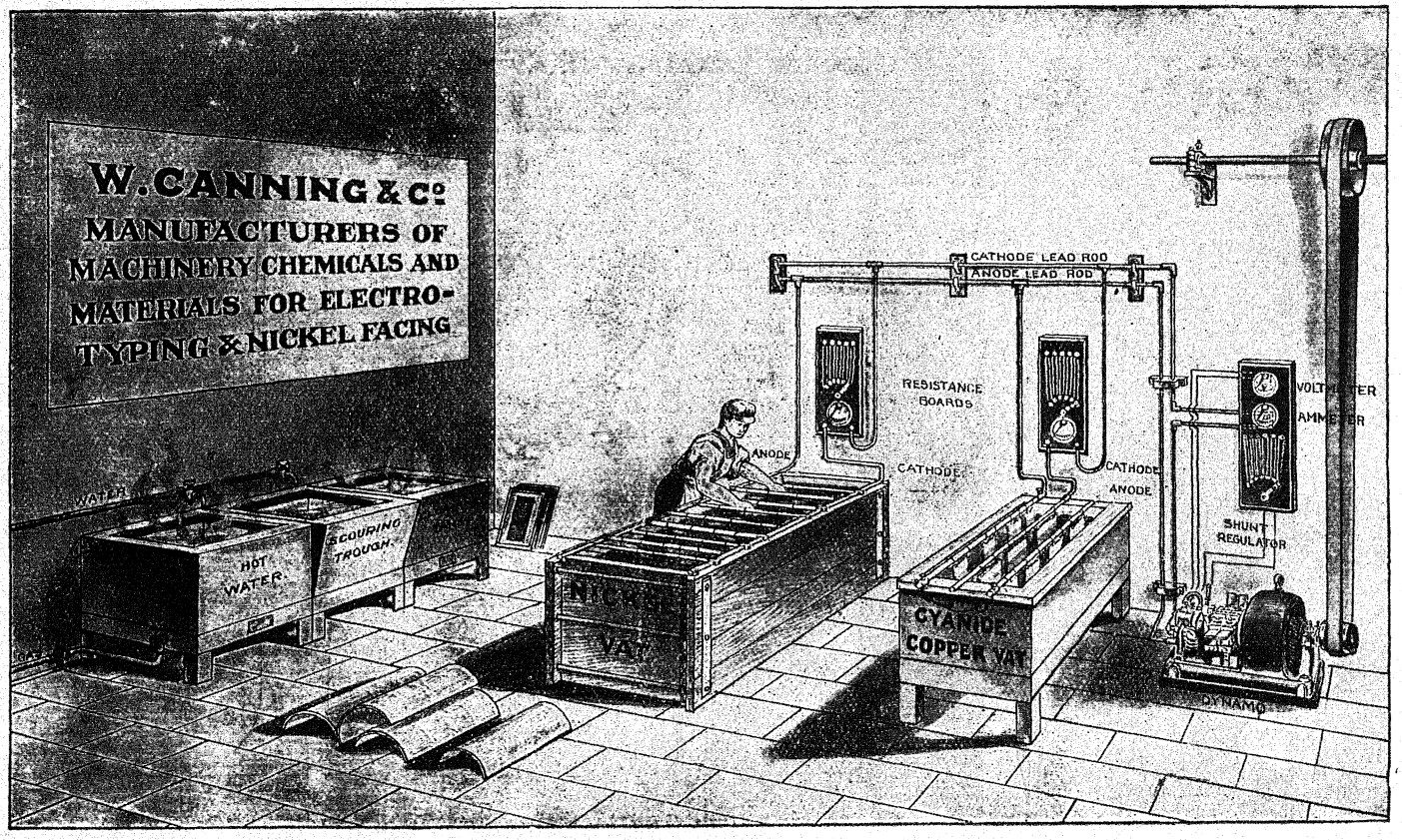


ILLUSTRATION OF NICKEL FACING PLANT.

The Anode should be mild steel plate, and the surface should slightly exceed the Cathode surface.

Voltage at the terminal of the Vat, 1 to 1½ volts.

Notes to be Observed. Steel-plating Solution is very liable to Oxidation, and this is exaggerated by leaving the Solution unused for a long period.

The Oxide falls to the bottom of the Vat with other impurities, and gradually the Solution becomes poor in metal, when fresh Solution should be added.

It is never advisable to throw away an old Solution altogether. Syphon off the clean Solution, and use it to mix with the new.

The Vats should be covered when not in use.

Stripping a Copper-plate of Steel. The Plate must be put in the Lyco Solution, and all grease removed; then swilled and put into a Solution of Sulphuric Acid, 10 parts; Water, 90 parts, until the Copper Surface is left quite bare. Afterwards swill in clean water, and put into the Steel Bath to be re-plated.

CANNING'S "LEITERIT."

THIS powder is a material specially prepared for the purpose of rendering non-conducting substances conducting, such as glass, porcelain, plaster casts, etc.

It has been found very valuable for the purpose of forming a conducting surface on wax moulds and for forming the conducting material in such mouldings.

The special value of the material consists in the fact that metal deposited upon it spreads over the surface of an article covered with it in a much less time than would be the case if ordinary Plumbago were used. Moreover the deposit is very firm, even and regular, and it will "throw" into the more hollow parts of the surface.

How to Use "Leiterit."

If the article on which a deposit is required is hard and has a rough surface, "Leiterit" can be applied by means of a camel-hair brush or a soft cloth, in a similar way to which Plumbago is used.

If, however, the nature of the article is such that the "Leiterit" cannot be brushed or rubbed on—that is to say, articles with very smooth surfaces, such as glass, porcelain, etc.—it must be applied in the following manner:—

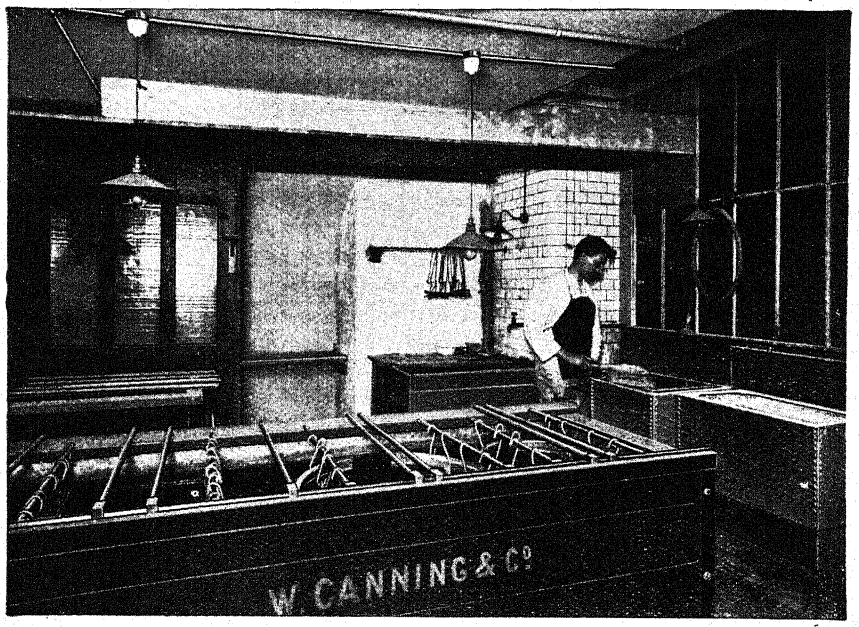
Take two parts of white wax for each part of beeswax, and melt the whole together. Stir well during the melting, add one part of the "Leiterit," and well mix.

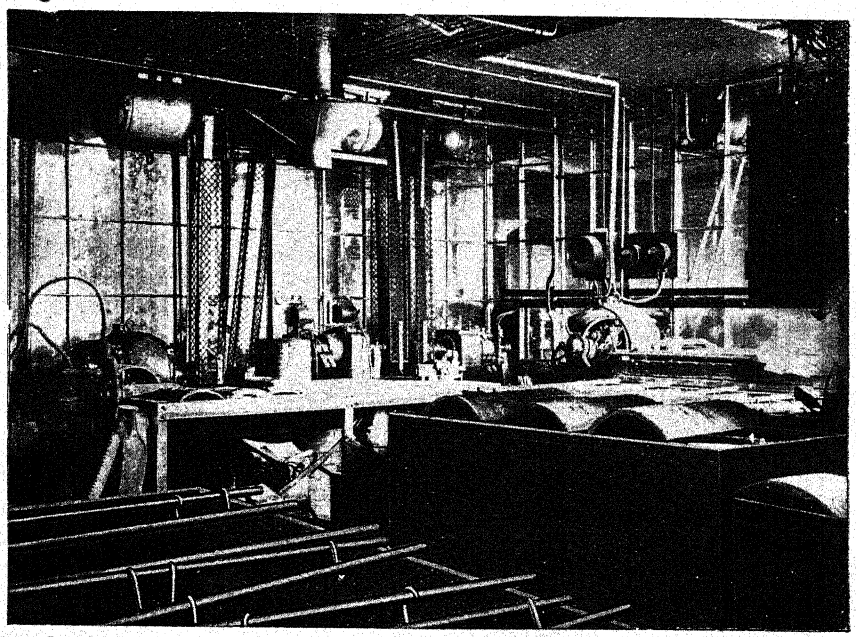
The whole mixture should then be allowed to cool, and when solid, melted and stirred thoroughly again. The process should be repated a third time.

An enamelled iron vessel should be used for making the mixture.

Having made the mixture, it is to be employed thus:—

Paint the surface to be deposited upon with a thin, smooth and even layer of the wax mixture while *both* the surface and the mixture are warm.





ILLUSTRATIONS OF NICKEL FACING PLANTS, SUPPLIED BY W. CANNING AND CO.

A camel-hair brush must be used for this purpose. The layer so formed should be allowed to become *quite cold* and then covered with a thin layer of "Leiterit." Both the "Leiterit" powder and the camel-hair brush used in this part of the operation must be perfectly dry, and the surface must be brushed until a perfectly smooth and even coating is obtained. This stage of the work is most important, and upon its effectiveness the success of the whole work largely depends. When a smooth, somewhat glossy surface has been obtained the article is ready for plating.

The wax mixture above described can of course be used for making wax mouldings. In this case also the surface of the moulding must be finished as detailed.

NICKEL FACING STEREOS.

After the stereo metal has been cast, it has a coat of Nickel deposited on its face to harden the surface. As the process of Copper- and Nickel-plating has already been fully described in this book, it is only necessary to describe the method adopted for stereo work.

The stereo is first cleaned in a Solution of "Lyco," not immersed *longer* than half a minute; then swilled in cold water, scoured (or brushed) with fine scouring-powder and a scouring-brush. The stereo is then immersed in the Cyanide of Copper Solution for about 5 minutes to receive a coat of copper, taken out, swilled in cold water, and scoured (or brushed) again to see that the deposit covers the whole surface. If the whole of the surface has not received a perfect deposit, the stereo must be replaced in the Copper Vat, and the process repeated. When the stereo has received a perfect coat of copper, suspend it in the Nickel Vat from 15 to 30 minutes or longer according to the number of prints required. The length of time the stereo should be left in the Vat can only be determined by the number of prints required—in some cases 10 minutes, and in others 40 minutes will be necessary. When sufficient nickel is deposited, they are removed from the Nickel Vat, swilled in cold water, then hot water, and passed on for printing.

In nickel-plating stereo metal, either rotary or flat plates, the method adopted is the same as that described on pp. 43 to 55.

Notes to be Observed. Be careful not to leave the stereo in Cleaning Solution more than half a minute, as the metal is dissolved in it, and the fine sharp lines will be destroyed. Be careful to see that the copper deposit is sound before placing in Nickel Vat, or the stereo will blister when put on the machine, and bad printing will be the result.

ELECTRO DEPOSITION OF ZINC.

For Light Deposits:—

Canning's "Zonax" Zinc Salts	12 ozs.
Water	1 gallon.

Dissolve the Salts in the water, and if the Solution is used cold, work at 65° Fahr.; if warm, about 120° Fahr. A quicker and brighter deposit will be obtained by using the Solution warm. Work at 3 Volts for a dis-

tance of 6 ins. from Anodes to Cathode, and increase ½ Volt for every 2 ins. extra distance. If an oxide forms on the Anodes when working, add carefully about ½ oz. Cyanide Potassium, "Zonax" Brand, 95% Grey, to each gallon of Solution, or more or less as required to keep the Anode clean.

A small quantity of the "Zonax" Zinc Salts should be added to the Solution from time to time to keep it in proper working condition.

Density should be 7° to 8° on our Nickelometer.

For *Cast Iron Work* add to each gallon of Solution 2½ ozs. Bisulphite Soda, 1¼ ozs. Carbonate Soda.

For Heavy Deposits:—

"AJAX" COLD ELECTRO-GALVANISING (COLD ELECTRO-ZINCING).

The "Ajax" Zinc Solution is specially suitable for depositing an "anti-rust" coat of zinc upon articles such as Nuts and Bolts, Screws, Nails, Washers, Plates, Cleats, Saddles, Staples, Springs, Grids, Air Bricks, Can Lips, Tubes, Rods, Motor and Motor Cycle parts, etc.

The deposit obtained is clean, smooth, and even, of a good grey colour; and if a dull finish is required, the article has an excellent appearance, while if a bright finish is wanted, scratch-brushing following the plating gives the required brightness.

This "Ajax" Solution is the outcome of years of careful experiment, has been thoroughly tested, and is giving excellent results in some of the most important works in the trade. It is quite easy to work and manage, and is suitable for Still-Plating or Barrel-Plating. A very heavy coating can be obtained, this being dependent upon the length of time the article is allowed in the Bath. A good deposit is obtained in 20 minutes or a heavy deposit in 50 minutes in a Still Bath.

A good deposit is obtained in a Mechanical Plating Barrel in 2 hours.

The figures are approximate only, as different articles require different conditions; further, so much depends upon the thickness of deposit required.

The deposit is made direct on to the Iron or Steel.

By this process much less Zinc is required to the square foot for protecting the article than is necessary in Hot Pot Galvanising; at the same time, the protection afforded to the article deposited upon is greater, the deposit being even and uniform, a difficulty which cannot be surmounted in Hot Pot Galvanising.

Sample articles can be plated, and firms interested can see their own articles actually done at our Birmingham or London Showrooms.

Painting exposed plumbing work which has been Electro-Zinced first makes a first-class job, without risk of subsequent rusting.

Instructions for Making and Working an "Ajax" Cold, Heavy Depositing Cold Galvanising (Zincing) Solution.

Condition of Vat. The Vat in which the Solution is placed should be made with wood, lined with pure Chemical Lead, and match-boarded over

the lead lining, and should be perfectly clean. If an old one is used, all crystallised salts, oxides, etc., should be entirely removed. The old match-boarding should be removed, the lead well washed, and new match-boarding put in.

Dissolving Salts. Into an *Enamelled Iron Vessel* put clean water, and when *nearly boiling* add 2½ lbs. of "Ajax" Salts to each gallon of water; well stir till the Salts are dissolved.

The Solution must not boil.

Do not use any vessel except one of Enamelled Iron for mixing the Solution, and do not remove any "scum" which appears on the top of the Solution, but stir till all is dissolved.

Placing Solution in Vat. "Ajax" Salts being a mixture, the *whole* quantity should be dissolved, and under no conditions part of the salts used. Pour the Solution through a filter made with muslin or similar material; if any Salts are left undissolved, replace in the enamelled iron vessel, add cold water to the Solution till it registers 17° to 18° on Canning's Nickelometer.

Temperature. The Temperature of the Solution should never be allowed to fall below 62° Fahr.

Anodes. Use a good set of pure Zinc Anodes. The Anode surface must be as large as possible. The Anodes must be removed from the Solution when the Vat is not in use, and before replacing should be well scoured in order to remove the loose solids from their surface.

Current. The current which may, generally speaking, be employed with "Ajax" Solution is 10 ampères per square foot. Never place work in a Solution until current is switched on, or allow it to remain in when the current is switched off.

Replenishing the Bath. This is only occasionally necessary. Nothing must on any account be added for purpose of replenishing, except such Salts as are supplied by us for that purpose.

After Article is Plated. After removing the article from the Zinc Solution, swill well in clean cold water, then through hot water, and dry in clean hot boxwood sawdust. Articles which are so constructed that they cannot be dried in sawdust can be allowed, after well swilling, to drain till dry. When it is important for the articles to keep their colour, swill well after plating in cold water, then swill in a hot Solution made of 1 oz. best yellow soap, 1 gallon water, and dry in hot boxwood sawdust.

Special Notes. Don't allow articles accidentally dropped in Vat to remain; remove them immediately.

See the article is perfectly clean before placing in Vat.

See the electrical conditions are conducive to good results.

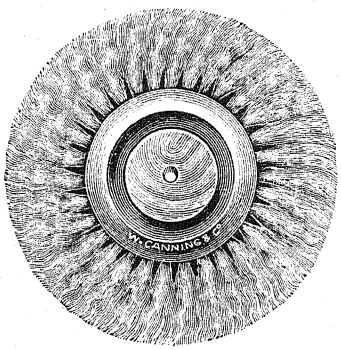
Well stir Solution at end of each day's work, and keep covered when not at work.

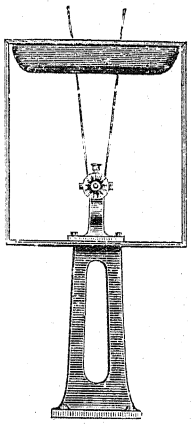
No solid substance should ever be added to Solution.

Swill all articles thoroughly. Never allow Cleaning, Copper, or other Cyanide Solution to get into Vat.

SCRATCH-BRUSHING.

THE sizes and varieties of Circular Scratch-brushes used for different articles during the various processes of manufacture are very great; reference to our *Catalogue* will give full particulars respecting the use of various brushes, and the speed at which they should be used. It should be clearly understood that Brushes of small diameter and fine wire run at a greater speed than those of a larger diameter and coarser wire; for, as the size of the Brush and thickness of wire increases, the speed should decrease.





WIRE SCRATCH-BRUSH.

Scratch-brushing is performed with a Circular Brush, also with scratch-knots secured in a chuck and revolved, or by hand.

Scratch-brushing with a Circular Brush. The Brush is placed on the screwed taper end of lathe, and is revolved according to the size of the Brush, as described above.

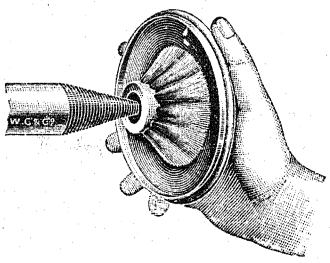
A Scratch-brush Box, as illustrated, is placed on the stand to prevent the liquid spurting about as it drops on the Brush (see p. 133).

To make a good Scratch-brushing Fluid add a tablespoonful of Canning's "Bruco" to 2 gallons of water. This makes a perfect Scratching Fluid, and is specially suitable for Wire Work, Chased and Cast Work.

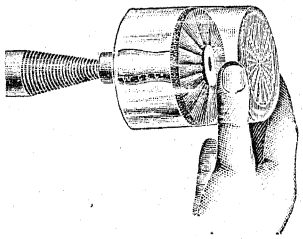
Another Solution is made by dissolving ½ lb. best White Double Size in 2 gallons of water, or, if Size is not at hand, 1 oz. of *good Glue* is dissolved in 1 gallon of water or Stale Sour Beer. Either of the above will do, the Size being used only on account of its quickness in dissolving.

When the Solution is made it is placed in the trough at the top of the Scratching Box, and about a gallon of the Solution should be allowed to

run through every fifteen minutes; the flow of the Solution is regulated either by a spigot or tap in the box, and care should be used to see that the Solution runs exactly between the Brush and the article being brushed

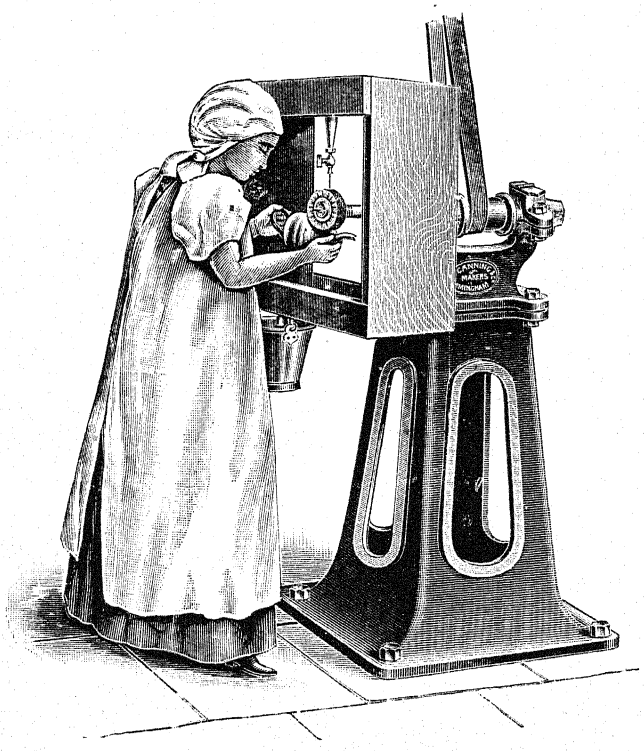


BOTTOM BRUSH.



END BRUSH.

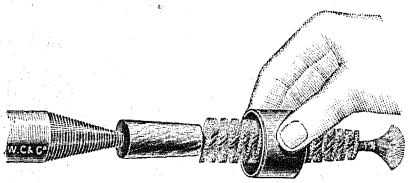
(and not upon the top of the Brush). The article should be brushed till it is perfectly bright, afterwards swilled, and dried out in boxwood sawdust.



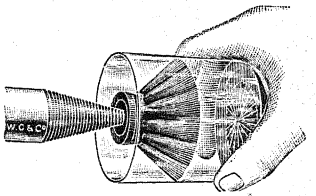
SCRATCH-BRUSHING.

A Bucket is placed underneath the Scratching Box to catch the liquid as it runs away, and the Solution is used several times over, so long as it is clean.

To prevent the Wooden Stock of the Brush splitting it is advisable to put the Brush in the Size or Glue Water a short time before using, and care should be used to see that the hole in the stock is large enough to

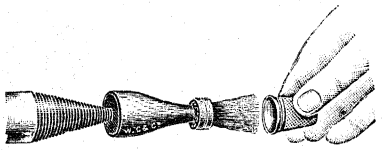


RING BRUSH.

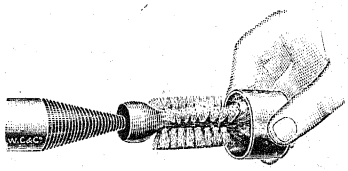


BOTTOM BRUSH.

screw on the taper end of the Scratch-brushing Lathe easily. If the hole is too small it must be either bored, scraped, or burnt larger; care must be used to keep the hole true, or the stock will be likely to crack. Also



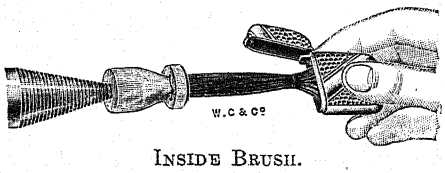
THIMBLE BRUSH.



RING BRUSH.

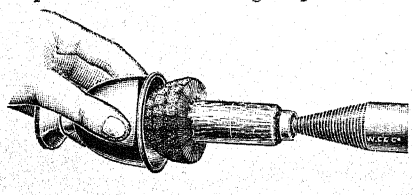
some melted lead can be poured into the stock as a preventive of the stock splitting.

Scratch-brushing with Wire Knots (see illustration on p. 136). The

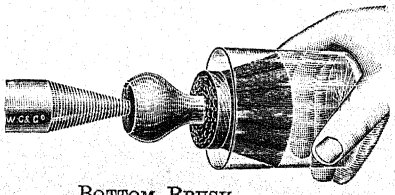


INSIDE BRUSH.

Knots are placed in a Brass Chuck or Wood Chuck, and fitted to the spindle of the Lathe, the size of Wire used depending on the work being operated upon. The Scratching Liquor is used as before described; this process is



CUP BRUSH.

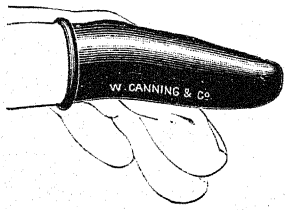


BOTTOM BRUSH.

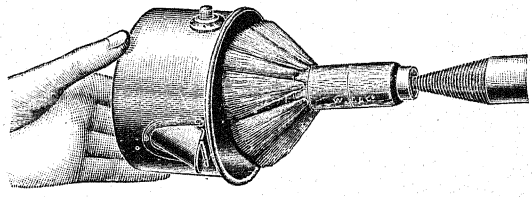
usually adopted for large articles, as the process is more economical than using Circular Brushes. The speed at which the Lathe should run is 800 to 1,000 revolutions per minute, according to the gauge of Wire in the Knot,

the finer size Wire Knot running at the higher speed, and the coarser one at the lower speed.

Scratch-brushing Silver-plated Articles. Brushes of various shapes are made for different articles, such as Thimbles, Egg Cups, Match Boxes, inside of Coffee and Tea Pots.

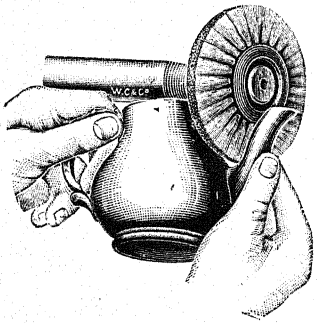


RUBBER FINGER-STALL FOR SCRATCH-BRUSHING.

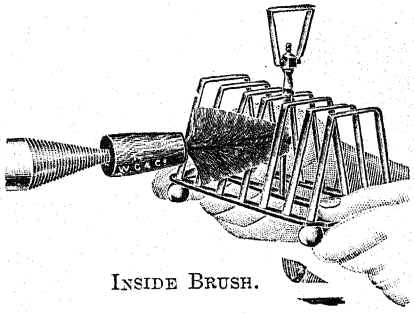


CUP BRUSH.

When the inside of an article is being brushed, care must be used to have plenty of Scratching Liquid on the Brush. When scratching large articles, such as Waiters, Dish Covers, Cruets, Vegetable Dishes, etc., knots placed in a chuck are usually employed, as before described. If



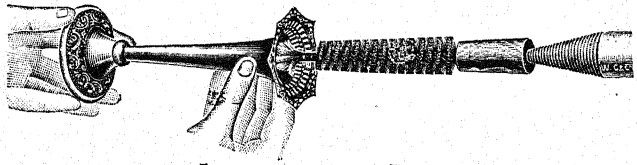
CIRCULAR SCRATCH BRUSH, No. 553.



INSIDE BRUSH.

the article is not adaptable to this form of Scratching, a Circular Brush is employed (No. 553). It must always be remembered that no hard and fast rule can be laid down for Scratch-brushing, as the Brush must be suited to the article under operation.

For scratching iron articles which have been Electro-brassed or



INSIDE AND RING BRUSH.

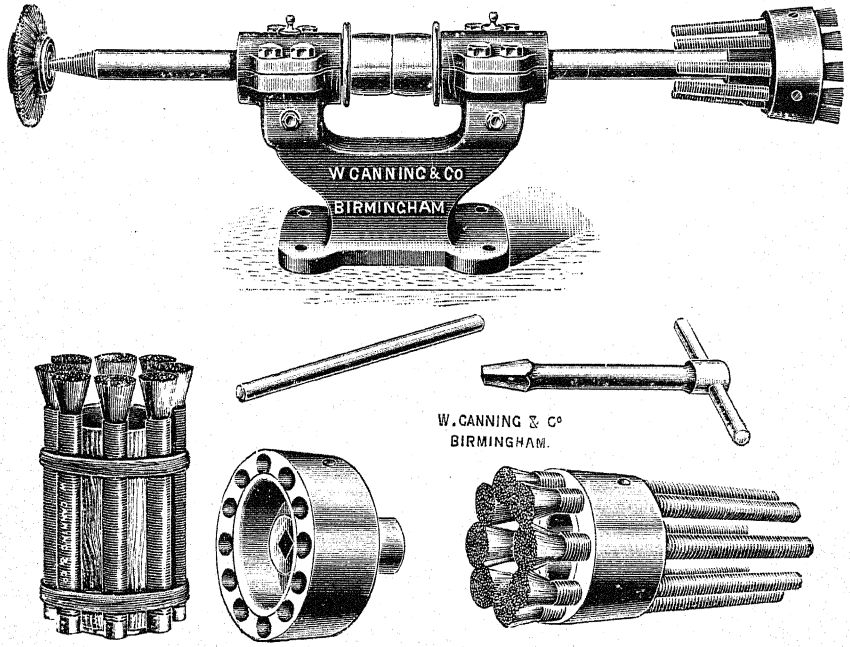
Coppered, the same instructions apply as in Scratch-brushing Silver-plated Articles.

Scratch-brushing Brass, Copper, and Iron Castings. Cast Brass, Copper, and Iron articles are often Scratch-brushed after being pickled, to remove scale and brighten the surface. Circular Brushes suitable for

this process are Nos. 555 and 556, and Scratch-knots 585 to 587, when the surface is large—that is to say, for such articles as Lamp Stands, Gas Stoves, Grates, Chandeliers, Electroliers, and large Brass and Copper Castings.

Frosting with a Scratch-brush. Brushes Nos. 550 to 554 are used for Frosting. When a coarse frost is required a better result may be obtained by using a Brake—*i.e.*, hold the article in one hand, and with the other hold a small piece of Iron or a Cork against the Brush to cause the wires to beat down on the article with greater force. This method is specially adapted for Cigar and Cigarette Cases, Medals, Bracelets, Lockets, and articles of like description.

Articles of Jewellery are Scratch-brushed with finer wire brushes, which are described in our *Catalogue, Nos.* 550 to 553, and 557 to 579.



SCRATCH-BRUSH LATHE AND CHUCKS.

Scratch-brushing by hand is carried out by vigorously brushing the article, and occasionally dipping the Brush in the Scratching Liquid (*See Hand Scratch-brushes, No.* 79).

Notes to be Observed on Scratch-brushes. See your Brushes run at the right speed. By attention to this point, you will obtain the best results, and lengthen the life of the Brush.

If Brushes with thick wire are run too fast, the wire will break off at the Wooden Stock.

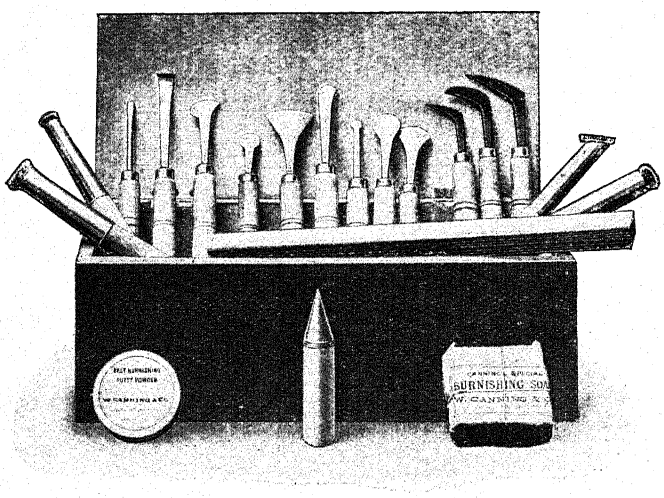
See that the Size or Glue is dissolved in the Scratching Liquid, or the Brush will get clogged.

The stocks of small Brushes are best filled with Molten Lead; but take care that the Lead is not too hot when poured in.

BURNISHING GOLD AND SILVER ARTICLES.

AFTER the article is perfectly dry and well wiped, Burnishing is the last process, carried out in the following manner, the materials used being Steel Burnishers, Bloodstone Burnishers, Soap and Water of the thickness of Paste, Polishing Buff, and Putty Powder.

BURNISHERS AT WORK.



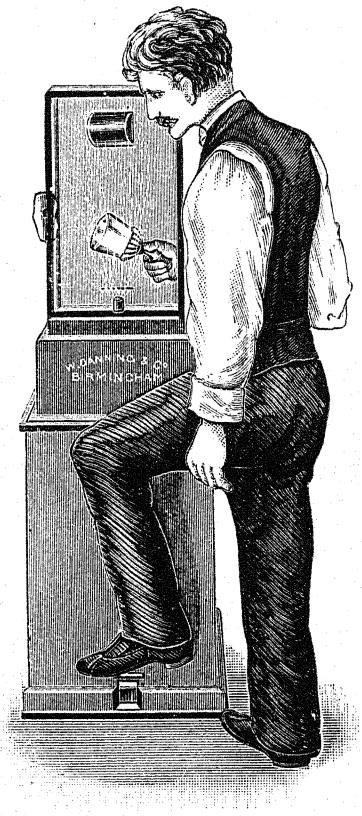
BURNISHING OUTFIT.

A Steel Burnisher is moved backwards and forwards over the surface of the article, which must be kept well moistened by dipping in the Soap. The shape of the Burnisher depends upon the article under operation

(*See Catalogue, No.* 641). After the article has been rubbed all over with the Steel, a Bloodstone Burnisher is used for giving the final brightness; this must also be moistened in the Soap and rubbed over the surface, as before described.

Both Steel and Bloodstone Burnishers must be kept well brightened and fine by rubbing vigorously on a Buff Leather Stick, over which is sprinkled Putty Powder.

After the article has been Burnished, the Soap must be washed off



SANDBLAST MACHINE.

in warm water, and the article dried in clean boxwood sawdust, then polished with a Soft Chamois Leather.

In some cases, after the article has been Burnished with the Steel Burnisher, it is washed, dried in boxwood sawdust, and finished on the Lathe with a soft Mop and Rouge.

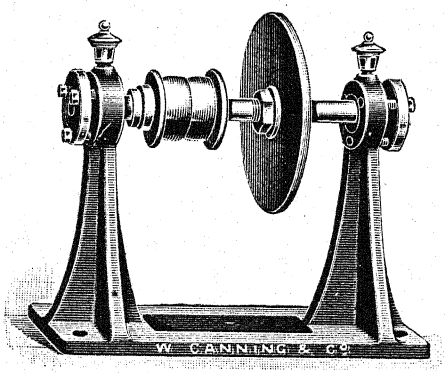
To make the Soap Paste, dissolve 4 ozs. Best Yellow Burnishing Soap in ½ pint of Hot Water. The water to be kept slightly warm and well stirred until the Soap is dissolved.

SANDBLASTING JEWELLERY AND SILVER WORK.

ARTICLES, such as Cigar and Cigarette Cases, Match Boxes, Cake Trays, Clock Faces, etc., are Sandblasted by a jet of air blowing Sand on to the article, and if suitable size material is used a fine or coarse matted appearance can be obtained. The machines made for this purpose are driven by power or by treadle. We illustrate the Treadle Machine.

GOLD CUTTING OR LAPPING.

THIS is carried out by revolving a disc of metal, which is called a Lap, on a suitable Lathe (see illustration), which must be run perfectly true, the Lap being usually turned upon the spindle on which it has to run.



LAPPING LATHE.

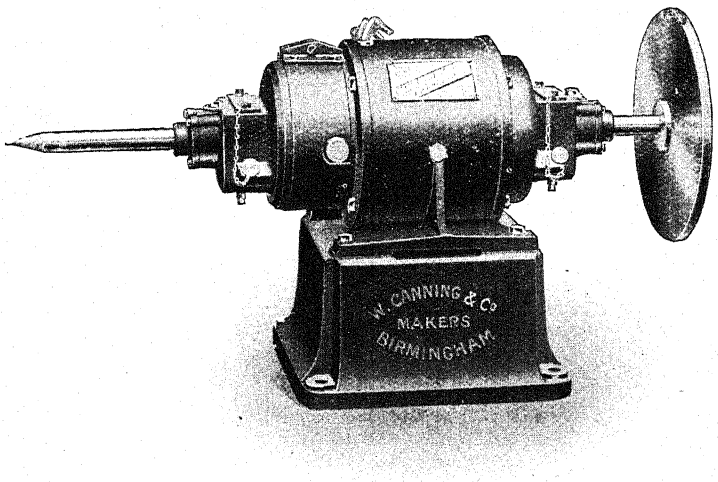
"Heading In." The Lap is dressed with Emery by a process known as "heading in." This is one of the most important processes of Lapping, and must be carefully carried out as follows:—

In a wooden watertight Trough, fitted with a suitable wooden hood or guard to prevent splashing, Treble-washed Flour Emery (*Catalogue, No.* 512) is placed, together with sufficient water to form a thin paste. This is applied to the Lap whilst revolving by means of a piece of round wood, at the end of which is fixed a pad of Cotton or Soft Rag, to which the Emery adheres. When a quantity of the Emery has been applied, it is rubbed gently into the Lap with a carefully selected smooth Flint Stone, having a flat side and well-rounded edges. Care must be taken that the Lap is not injured by too great a pressure.

The process is repeated until sufficient Emery is "headed in." This process imparts the fine cutting properties necessary for Lapping. The "heading in" must be repeated as the surface wears.

The process of Lapping can only be gained by experience, and is accomplished by a fine sense of touch which experience only can give. Lapping is, of course, only suitable for flat articles. The articles are held against the face of the Lap as it revolves until the desired surface is obtained.

Should the operator through inexperience scratch the Lap, the "heading in" process will remedy this, providing the scratch is not too serious.



COMBINED ELECTRIC MOTOR POLISHER AND LAPPER.

If, however, it is marked badly, it may be necessary to turn the Lap true again. This can be done by any engineer possessing a Turning Lathe, but it is important that the Lap is turned on the spindle, and not removed from the Spindle.

BATTERIES.

THE disadvantages of Batteries for use in Electro Deposition are dealt with in the introductory chapter of this work. They are suitable where a small amount of work has to be dealt with, such as Gilding, Silvering, and Small Nickelling; Cycle work, with the exception of very small parts, cannot with any degree of satisfaction be plated with them.

BUNSEN BATTERY.

The Bunsen Battery. This Battery (*Catalogue, No.* 270) is the most efficient and most commonly used of any for Plating. The round form here illustrated is the most convenient, and gives a larger surface of Zinc than any other, such as a rectangular shape. Renewals for round form are more easily obtained, and are less expensive than those for other shapes.

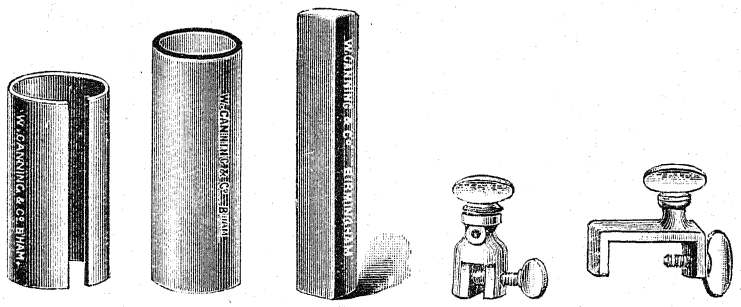
The output of these Batteries in Volts at their maximum is about 1·8 Volts, but this rapidly diminishes to about 1·5 Volts.

The internal resistance of these Batteries, when attended to with care, is low, so that the output in Ampères is considerable.

The following is the approximate output of Bunsen Batteries when in good working order :—

6 ins. high	..	..	..	..	..	5 to 6	Ampères.
10 „ „	..	..	..	..	..	10 to 12	„
12 „ „	..	..	..	..	..	14 to 16	„
16 „ „	..	..	..	..	..	20 to 25	„

The construction of these Batteries is an outside Jar of Brown Stoneware, containing a Circular Zinc Plate with suitable Connection, which



ZINC. POROUS CELL. CARBON. ZINC CONNECTION. CARBON CONNECTION.

surrounds a Porous Cell, inside of which is a Retort Carbon and suitable Connection.

When first setting up a Battery the Zinc must be amalgamated with Mercury.

To amalgamate the Zinc, a Solution of Canning's "Lyco" (*Catalogue, No.* 345) or a Solution of "Zonax" Brown Potash (*Catalogue, No.* 337)

AMALGAMATING TROUGH. AMALGAMATING BRUSH.

should be made, and the Zinc put in it for some minutes. This is to dissolve all grease, as with new Zincs oil is frequently present. Rinse well in water, and rub over with Silver Sand or Powdered Pumice-stone. Dip the Zinc into the Dilute Sulphuric Acid of the outer Jar; take out, and scour the Zinc well with Mercury in an Amalgamating Trough (*Catalogue, No.* 283) with an Amalgamating Brush (*Catalogue, No.* 284).

The Mercury may also be rubbed in with a rough cloth or with hemp.

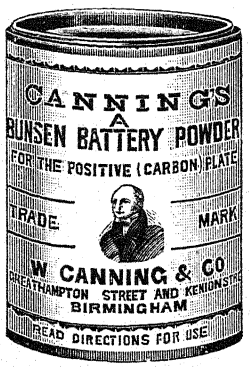
Setting up the Battery with Acids. The Porous Cell should be soaked in water before the Battery is first used. This Cell is filled with Nitric Acid (commercially pure, as chemically pure is unnecessary), or with Aqua

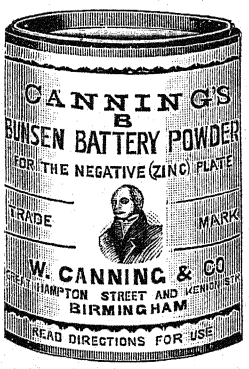
Fortis to within ½ in. of the top. The outer jar is filled level with the Acid in the Porous Cell with Dilute Sulphuric Acid. The Sulphuric Acid should be diluted, one part Acid to twelve of water in a separate jar. *Care* must be taken that the *Acid is added to the water*, and not *vice versa*. Do not use this Acid till quite cold after the mixing.

Renewals of Acids. If the Batteries are constantly worked, the Acid will need entire renewal every three to four days. Oftentimes a little fresh Acid is added to the old, at intervals of a few hours, to give life to the Battery.

When at Rest the component parts of the Battery should be dissociated. The Nitric Acid should be poured into a separate jar, and the cell put into water, the Zinc taken out, swilled, and left in clean water.

Acid Fumes. The disagreeable Acid Fumes evolved in working Bunsen Batteries should be carried away as conveniently as possible by a flue, or some such arrangement. If possible, the Batteries are best placed outside the Plating Room—the open air is the best place, a protection against the weather being provided. If worked in the Plating Shop, they are best placed as high as possible on shelves, as the smell of the fumes is thus obviated as far as possible.





Setting Up with Canning's Battery Powders (*Catalogue, No.* 290). In many places, particularly in country districts or abroad, the cost of Acids is prohibitive in small quantities, owing to the heavy rates for carriage. It is not claimed that these Powders are more suitable to use than Acids, but they are the outcome of many experiments, and practical experience testifies to their reliability for all ordinary purposes. Their large and increasing sale is ample guarantee of their value. These Powders must never be used except in conjunction. No disagreeable Acid Fumes are evolved. The Zinc should be amalgamated, as previously described. The Porous Cell being filled with water, 2 ozs. of the A, or Positive, Powder are dissolved to each pint of water. The B, or Negative, Powder, for the outer jar, is dissolved 3 ozs. to each pint of water. At the starting of the Battery a strong current is developed, afterwards becoming slightly weaker, when a little of the A. or Positive, Powder should

be added at intervals to the Porous Cell. The voltage developed is about 1·3 Volts when these Powders are used, slightly less than when Acids are used. It will be seen that the quantity of B Powder required is nearly double that of the A Powder. Both are packed in packages of convenient size.

Connecting Up for Work. Theoretically, only as much Zinc should be dissolved as is chemically equivalent to the amount of the metal being deposited. The source of the current is in the Zinc being dissolved, which is termed the Negative Pole, and the Carbon the Positive Pole ; so the Zinc must be connected to the work and the Carbon to the Anodes. As one Battery is seldom enough for the work required, two or more are usually employed, and must be connected up in different ways for different conditions of electrical output, thus :—

(A) **For Increased Voltage only.** Taking the E.M.F. of one Battery to be 1½ Volts, it follows that the Battery is unsuitable for Nickelling, Coppering, or Brassing, for large quantities of work at one time. Two Batteries can be made to give 3 Volts, if the Zinc of one is connected to the Carbon of the other, and the other two terminals to the Vats. In the same way three Batteries will give 4½ Volts, and so on. *By this arrangement it must be noted that the quantity of current available is the same as if one Battery alone was used ;* where more than two Batteries are used, the following method is usually employed :—

(B) **For Increased Voltage and Ampères.** If four Batteries are used, they should be put two in a row. Connect the two in each row as in (A), and connect the two remaining Carbons and the two remaining Zincs to the Anodes and the work in the Vat respectively. In this case the Voltage is the same as for one row—namely, 3 Volts ; but the Ampèrage is doubled and is twice the output of one Battery. If six Batteries are used, they may be used in two or three rows ; if in three rows, the Voltage remains at 3 Volts, and the Ampèrage is three times that of one Battery ; if arranged in two rows, the Voltage would be 4½ Volts, and the Ampèrage only double that of one Battery, and so on for any number of Batteries.

(C) **For Increased Ampères only.** Where a quantity of current is needed with a low Voltage, the Carbons should be connected together and the Zincs together. This arrangement gives 1½ Volts only, but the Ampère output is the multiple of the Ampèrage of one Battery by the number of Batteries. So if six Batteries are used, each with an output of 6 Ampères at 1½ Volts, the output of the whole will be 36 Ampères at 1½ Volts.

Special Points. It is not advisable to attempt deposition with Batteries when the quantity of solution exceeds 20 to 25 gallons.

In purchasing Batteries it is always wise to purchase two small ones, instead of one large one, as the range of the work that can be plated is thus extended through the different combinations possible in connecting up the Batteries.

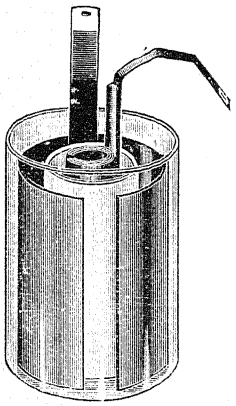
Always remember when diluting the Sulphuric Acid to add the Acid to the water, or otherwise serious accidents may occur.

Give Zincs attention, and see that they are frequently amalgamated.

Owing to the fragile nature of the Porous Cells, always keep one or two spare ones in stock for emergencies.

Although not recommending other than the Bunsen Battery for plating, the Daniell Battery is sometimes used, and is shortly described.

The Daniell Battery (*Catalogue, No.* 293). This Battery consists of an outer Glass, or Stoneware Jar, Copper Cylinder, a Porous Cell, and inner Circular Rod of Zinc. To charge, a very strong Solution of Sulphate of Copper must be made and put into the outer Cylinder. Add a few extra crystals to this; mix some Dilute Sulphuric Acid (about 1 of Acid to 10 of Water), as described under Bunsen Batteries, and when cool put it in the Porous Cell level with the Sulphate of Copper Solution. The great inconvenience of this Battery is the constant additions of Sulphuric Acid required. The E.M.F. of one of these Batteries is usually 1 Volt, and the Cell is of special value owing to its constant Voltage. As in all Batteries where Zinc is dissolved, the Zinc Connection is the negative and connected to the Cathode Rod in the Vat. If several of these Batteries are used, they can be connected, as previously described. Amalgamate the Zinc as described on p. 141.



DANIELL BATTERY.

The Bichromate Battery. This Battery gives a good plating current for short operations, but is useless except for Gilding and Silvering small articles and for use at intervals. The form recommended is the bottle shape, with two Carbon Plates usually fixed and a Zinc Plate amalgamated as described on p. 141, which can be lowered into the Battery between the two Carbon Plates. The Battery is charged with a Solution of 5 parts Water to 1 of Chromic Acid. They start with a strong current, but the development becomes weaker and weaker. It can, however, be revived by addition of some fresh Chromic Acid, but an entirely fresh charging soon becomes necessary. Voltage per Cell approximately 1·8 Volts.

Le Clanche and Dry Batteries are of little use for any Electro-plating operations, except for a few moments to do Amateur Gilding or Silvering.

Note. In all cases where Zinc is dissolved it is necessary to remove Zincs from Cells when not in use. Also see pp. 154 and 166.

ACCUMULATORS, OR SECONDARY BATTERIES.

ACCUMULATORS are specially suitable for Electro-plating when the speed of the engine driving the Dynamo varies, and, as a direct result, the current from the Dynamo is irregular. It is most important when some metals are being deposited that no variation in the current takes place. It is not always possible to regulate the voltage of the Dynamo up or down as may be required, and there is certain work for which it is absolutely necessary, when once started, the current should remain constant without a stop until it is finished. For Electrotyping, Accumulators are

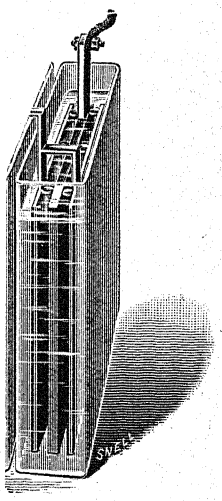
of the greatest value, also in Plating Shops where the plating can go on without stopping during meal times, and when the engine is stopped occasionally.

It must always be remembered that each individual cell, irrespective of its size, takes 2½ volts to charge, and discharges at 2 volts. The number and size of the plates in each cell regulates the quantity of current accumulated, which is known as ampères. When the cells are charged, the quantity of current taken from them depends how long they will give out current. For example, a small cell will discharge at the following rates :—

30 ampères for 2 hours,
or 24 „ „ 3½ „
or 16 „ „ 7 „

at 2 volts per cell.

In fixing Accumulators, the plates are coupled to two stems. One is the positive, marked +, and the other the negative, marked —, and it must be remembered that any metallic or conducting material connecting in any way the plate of the + with that of the — is causing a leakage. The positive pole of the Dynamo must always be coupled to the positive (+) pole of the Accumulator; or, in other words, it takes the current in at the positive pole and gives it off at the positive pole. If this is always remembered, there can be no connecting up wrongly.



Great care must be taken to guard against stopping the Dynamo when the Accumulator is connected to it. A Switch of ordinary single pole type can be inserted in one of the leading wires, but as the cause of stoppage is often an accident, the means of breaking the circuit should be automatically controlled by the Supply Current. We have designed for our low voltage work a Special Automatic Cut-out. They are made to carry the full current without undue heating, and will automatically cut out immediately the supply is reduced below a certain point. They can also be fitted with an Electrical Alarm Bell, which can ring anywhere desired to attract the attendant's attention. The value of this Automatic Cut-out must not be under-estimated, because, should the Dynamo stop by some accident, there is a possibility of the Armature being burnt out and the rapid discharge buckling the plates of the Accumulator and rendering them useless. Thus it will be seen the principal benefit of having a reserve current would be lost.

Buckling. If the Accumulators are charged or discharged at too rapid a rate, one plate will buckle towards the other coming in contact. No attempt should ever be made to bend them back, but small taper wedges may be inserted just sufficient to separate the plates, and these can be tightened from time to time, and the plates will eventually get

back to something like their original shape. The wedges should be of fibre or hard wood. Great care should be taken to prevent vibration, and all sediment should be removed from the bottom of the cells at least once a year

It should be understood that when the term "coupled in series" is used, it means when the + (positive) plates of one cell are coupled to the — (negative) of the next; and when the term "in parallel" is used, it means all + (positive) plates of all cells are coupled together, and all — (negative) plates of all cells are coupled together.

The Accumulators should always be placed as close to the Vats as possible, and attention should be paid to the following points. They should be placed on insulated shelves or racks, with no water, gas, or other pipes or iron or metal near or touching them. They should be absolutely free from vibration and dust, also be kept in a moderately cool place. If the cells are thoroughly insulated, and there is no means of leakage, the Accumulators will hold their charge for a long time.

Accumulators are constructed in so many different ways that it is impossible for us to give instructions as to the erecting, but full working instructions are always sent out with them.

In the illustration on the following page is shown a Dynamo connected to an Accumulator and to the vat, also a Board having a Volt and Ammeter, an Automatic Cut-out, and a Change-over Switch. When the Change-over Switch is in position marked No. 1, the current from the Dynamo is passing into the Vat, and is also charging the Accumulator through the Automatic Cut-out. When the Change-over Switch is in position No. 2 the Dynamo is not working, but the current out of the Accumulator is passing into the vat. When the Change-over Switch is in position No. 1, and the Resistance Board for the Vat is on the Off Stop, there is no current passing into the vat, but the current from the Dynamo is charging the Accumulator only.

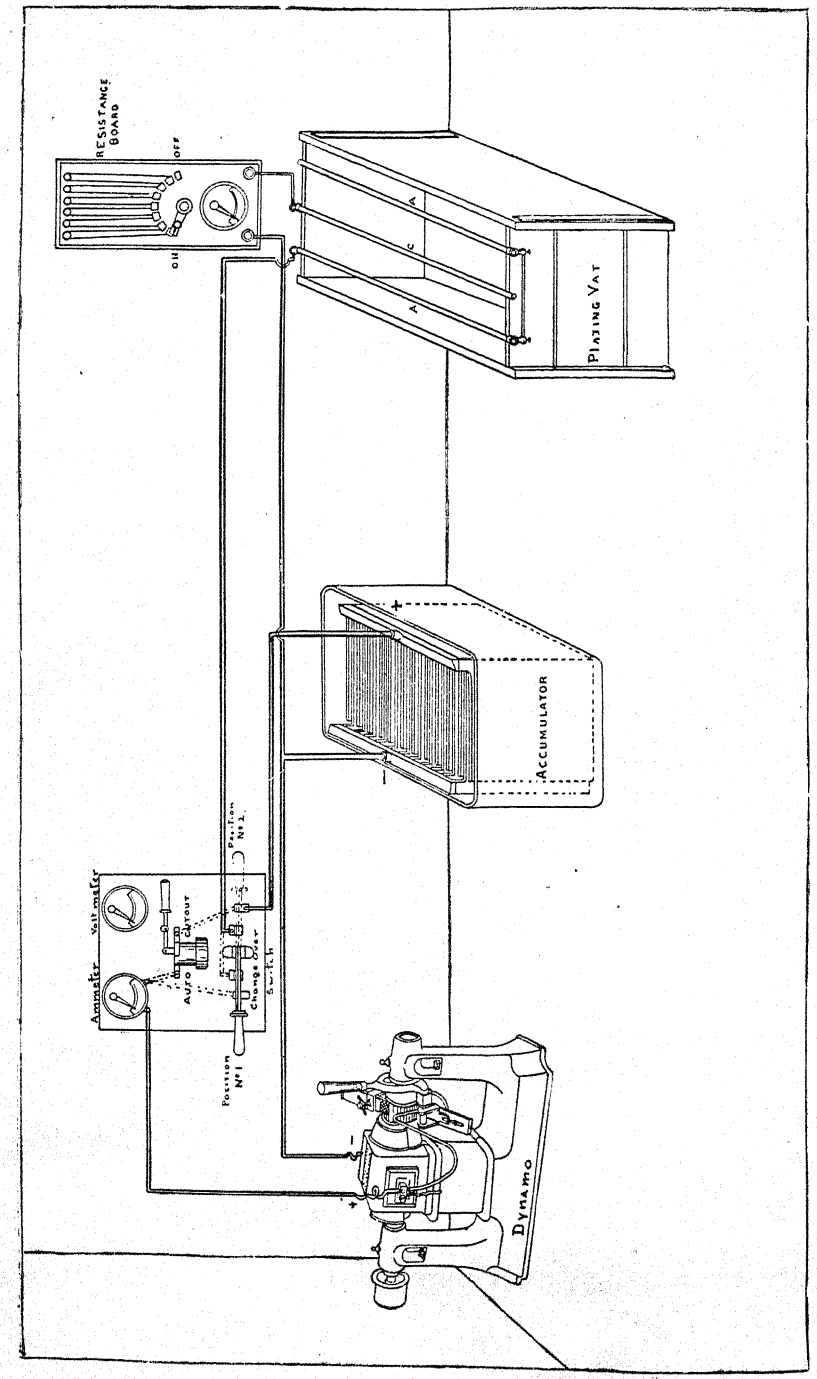
This illustration is given to show the different connections which can be made in a practical manner, and any number of Vats can be connected up in the same way.

NOTES ON THE WORKING OF ACCUMULATORS.

Acid must on no account be put in until the cell is ready for charging. Only pure Brimstone Sulphuric Acid must be used (free from impurities), and must be diluted to the strength for the Accumulator in which it is to be used.

The Dynamo used for charging should be shunt wound. Nearly all Plating Dynamos are constructed thus.

Charging should be commenced immediately after the solution is added, and should be as continuous as possible for the first charge. On no account should the Dynamo be stopped for the first twelve hours, nor should the Battery be used to supply current until the Acid in the cell


RESISTANCE BOARD
OFF
PLATING VAT
ACCUMULATOR
Position No 2.
Position No 1
Dynamo

has turned milky, in consequence of the vigorous evolution of the gases from both positive and negative plates.

The Accumulator should always be kept as fully charged as possible, in order to avoid risk of complete discharge.

The Accumulator must be switched out of circuit before the Dynamo is stopped, unless an Automatic Cut-out is used.

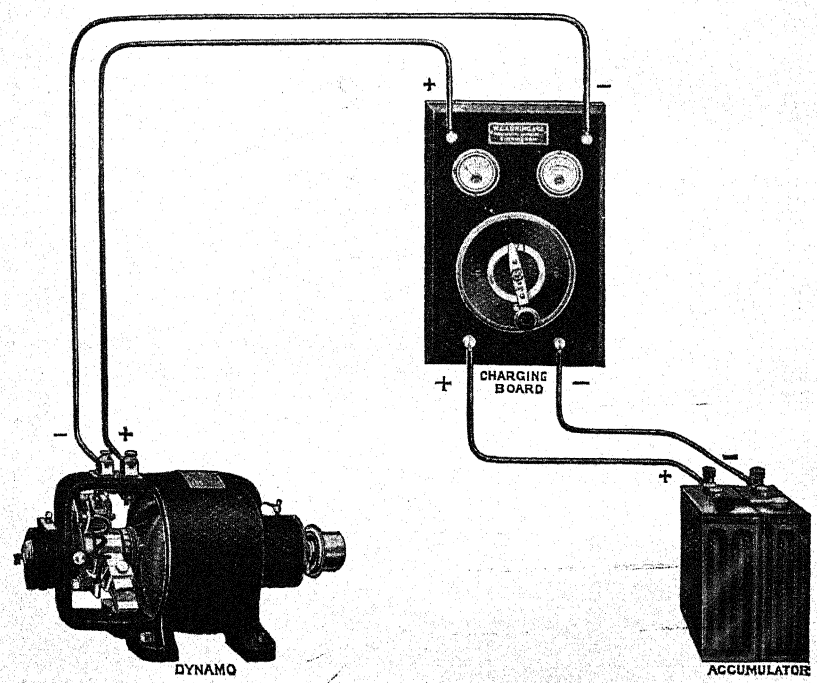
The plates in the Accumulator must be kept covered with liquid, any loss of which must, when necessary, be made up to the right level.

If it is required to leave the Accumulator out of work for any length of time, the Acid must not be removed, but the Battery should previously be fully charged, and care taken that the plates are always covered with liquid, by which means the cells will be kept in order for a reasonable time.

In fixing the Batteries, it is well as far as possible to fix them in a position where the fumes from them can escape into the open air.

CHARGING MOTOR CAR ACCUMULATORS.

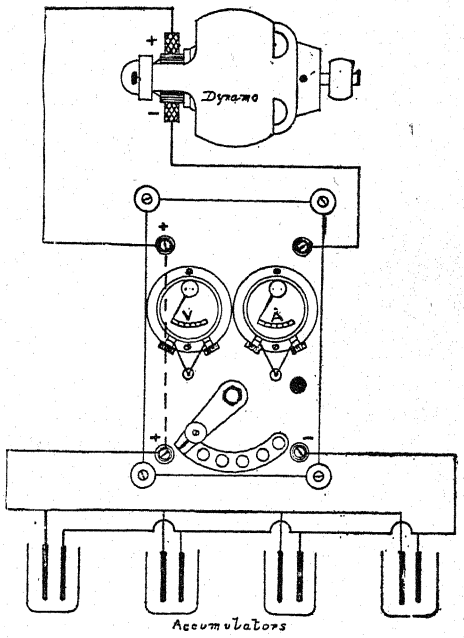
In charging Accumulators for Motor Cars, a Plating Dynamo can be used, but it must always be remembered that each individual cell, irrespective



of its size, takes 2½ volts to charge; the number and size of the plates in each cell regulates the quantity of current accumulated.

For using an ordinary Plating Dynamo or a Dynamo specially made for charging Accumulators, a Resistance Board with Meters similar to that illustrated must be used, and from the positive connection on the Dynamo, which is the one that goes to the Anodes in the Vat, must be connected the positive terminal on the Resistance Board and also to the positive terminal on the Accumulator, and these are all marked +. The positive pole of the Battery is often indicated by a red painted terminal. The negative wire will be connected to the negative terminal of the Dynamo, then to the Board, and then to the negative terminal of the Accumulator marked —.

CHARGING BOARD.
Diagram of Connections.



The bulk of ignition sets consists of two accumulators, coupled in series, taking a charging E.M.F. or Voltage of 5 to 6 Volts, and a current from 2 to 6 ampères. It will readily be seen that any Voltage in excess of 6 Volts is a loss, and must be cut down by means of an external resistance; consequently, the most important point, therefore, is to reduce that loss to a minimum. It will not be hard to realise that to permit a loss to continue during the hours of charging will, in a short time, exceed any initial outlay necessary to purchase the right apparatus. There are two methods of charging Accumulators—viz., Parallel, and Series. We will endeavour to point out the advantages and disadvantages of both methods.

Parallel means that each set of Accumulators is coupled independently to the regulating device, and thence to the supply, thus :—All positive to one pole, all negatives to another.

The advantages of this method are :—

Each set of Accumulators can be connected and disconnected without in any way interfering with the others being charged at the same time.

The make of cell (area of plates) does not in any way affect the charging of different makes (and area), each being charged at one and the same time providing that each set consists of two cells only coupled in series.

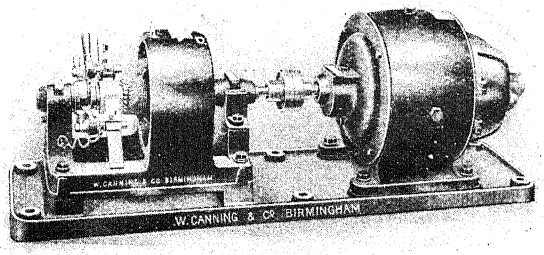
The state of discharge of one does not interfere with or control in any way the charge being put into the others; or, in other words, each set of Accumulators, providing the voltage at their terminal (5 to 6 volts) is correct, is absolutely independent of the others.

A defective cell can be detected by the amount of current which passes through it when connected up.

If an individual Resistance Board is used, the exact charging condition of each set can be seen at a glance.

Generators, or Supply Current. Accumulators can only be charged off *direct* current machines or mains; if the supply is *alternating*, a motor generator must be used to transform the alternating current to direct current. If engine or power is available, we advise one of our *shunt-wound low-voltage Dynamos*, specially designed for long continuous running, having every detail of our larger machines, which are most economical in power and self-regulating to the current demand.

It is not necessary, as in the case of Electric Lighting, for these machines while charging to have an absolutely steady drive. If the speed is subject

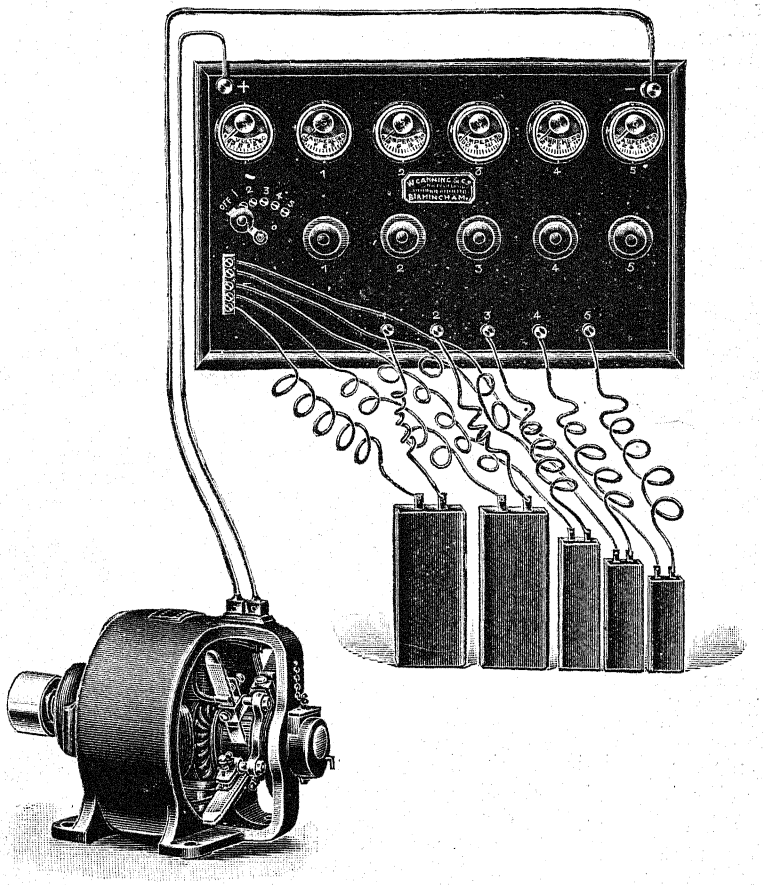


MOTOR GENERATOR FOR ACCUMULATOR CHARGING.

to much fluctuation, the Dynamos should be run at about 5 per cent. over the speed marked on name-plate, after allowing for belt-slip, so that when running at its minimum the voltage would never drop below 5 volts. If mechanical power is not available, and electricity for lighting is installed, the best and most economical method of charging is by means of a Motor Generator, which will transform the lighting or power current of 110 or 220 to 6 volts. They are made to give from 2½ to 50 ampères at 5 to 6 volts. The Motor Generator consists of two separate machines, Motor and Generator coupled together and bolted on a bedplate. Where the supply is alternating current, the motor is designed for alternating instead of continuous, and is coupled to the low voltage direct current generator. The great advantage of a Motor Generator is that with proper automatic gear it may be left running without attention for long periods.

Regulating and Measuring Devices. It is absolutely necessary to know what current is passing into the accumulators to determine whether they are being charged correctly. When a set is nearing a full charge, the charging current will gradually fall off; then again the current specified

on the sets as charging capacity must on no account be exceeded, and this can only be detected by the use of an Ammeter. We also strongly advocate the use of a Voltmeter, so that, in case of trouble, it would be an easy matter to determine the terminal voltage of the Accumulators. The operator can tell instantly if the proper amount of current is not flowing, and, if so, something is wrong—possibly due to a broken or dirty connection or a short-circuited cell. Without these instruments, it would be impossible to locate the trouble—possibly the machine or source of supply would be blamed for a defective cell, or a good cell might be blamed for a defective machine or bad contacts.

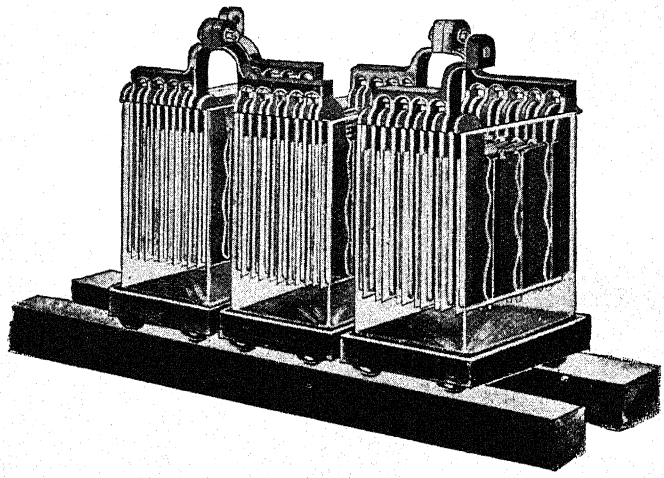


INDIVIDUAL CHARGING BOARD WITH FIVE INDIVIDUAL RESISTANCES AND FIVE AMMETERS.

Charging Boards of Various Types. The resistance used is very slight, and at the same time allows a range for adjustment from one cell up to whatever the boards are specified to carry. Terminal connections for these boards, permitting the individual sets to be attached at will without interfering with the others, should be used.

For charging Accumulators of various makes and sizes at one time, we recommend a Board with individual Resistance to each set. The number of Resistances placed on a Board can be multiplied to any extent: The Resistance consists of two coils of special high Resistance Wire, mounted on a suitable base; by pulling out or pushing in the handle, as shown in illustration (p. 151), the Resistance is cut in or out.

If power is available for only a short period during the day, Accumulators of very large capacity can be charged; then the small ignition Accumulators can be connected to these larger Accumulators, and charged at the usual rate. Three cells are necessary for this, and a charging current of 7½ to 8 volts. Although not quite so economical a method, this is a very reliable and satisfactory way. It should not be attempted without the usual charging Board and Ammeters, because a defective

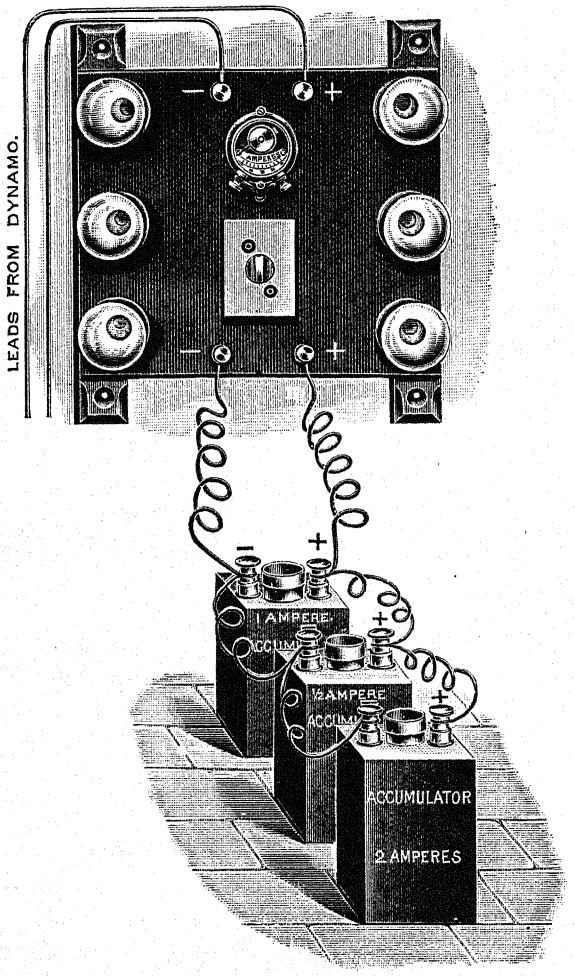


LARGE CAPACITY ACCUMULATORS.

ignition set put on to charge might run the large Accumulators down without the operator's knowledge. These can be fitted with a change-over switch, permitting the ignition Accumulators to be run direct from Dynamo while it is charging large cells; then when Dynamo is stopped, the charging can be finished from large cells.

Where it is an advantage to leave the cells while being charged, or where the source of electricity is likely to be shut off suddenly, it is very desirable to have an Automatic Cut-out, that in case of accidental stoppage of current will prevent the cells discharging themselves, and possibly buckling the plates and burning generator and connections. We have designed an Automatic Cut-out that can be adjusted to varying loads, and if used in conjunction, can be made to shut off the main or supply current, or, if required, can be made to ring a bell and attract attention as well as cut off connections, if from any cause the current should fail.

Series Charging. Series means that the positive of one set is coupled to the negative of the next, sufficient sets being coupled up in this way to equal four-fifths of the voltage of the charging supply—viz., if charging



CHARGING CELLS OF VARYING CAPACITY.

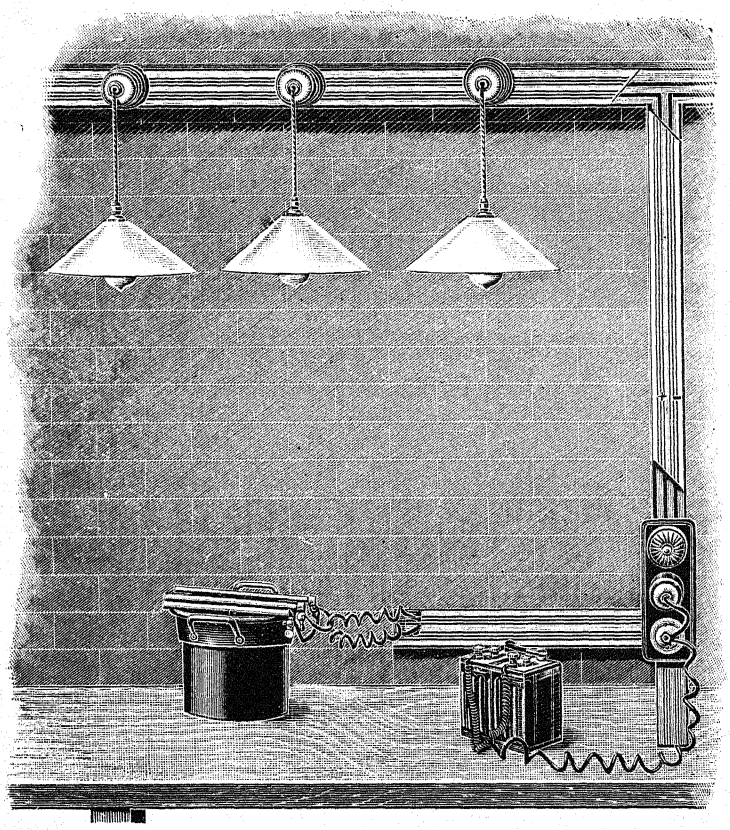
from 110 volts current, it would necessitate 22 sets being coupled in series, or sufficient resistance being inserted to equal that number.

The disadvantages of this method are :—

That only the minimum current taken by the smallest set can be passed through the series, otherwise the small set would be spoiled by charging too rapidly. This means serious loss of time and necessitates careful watching.

The impossibility for anyone except a manufacturer of Accumulators to always be in a position to put sufficient sets of one size on at a time to fill the series.

It is difficult to detect a cell that is short-circuited or defective. Hours of charging may be put into a cell, the plates of which may be touching or bridged over by spongy lead settling in the bottom of the



ADAPTOR FOR CHARGING ACCUMULATORS

cell; if charged in series, this cannot be detected until disconnected and tested separately.

When a Charging Board is used, such as Nos. 2170 and 2171, the difficulty of continual supervision is removed, as with this type of Board the voltage is constant, and can be taken from the street mains supply or from private installations for electric light, but in all cases must be continuous current. Each lamp holder is provided with a switch to allow any number of lamps to be used at one time.

Another method of charging is shown which will allow of cells of

varying capacity to be charged at one time (see p. 153). Below is a table showing the current which will pass through the board, with voltages from 25 up to 220, and with any number of lamps from 1 to 6.

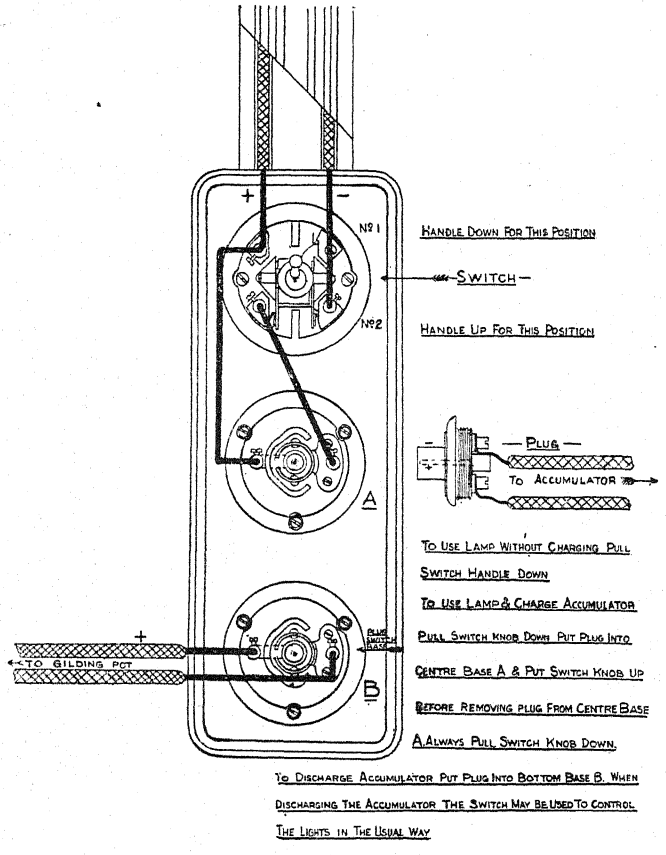


ILLUSTRATION OF ADAPTOR NO. 2221.

Voltage of Dynamo or Supply.	1-16 C.P. Lamp.	2-16 C. ¾ P. Lamps.	3-16 C.P. Lamps.	4-16 C.P. Lamps.	5-16 C.P. Lamps.	6-16 C.P. Lamps.
	amps.	amps.	amps.	amps.	amps.	amps.
25	$2\frac{1}{2}$	5	$7\frac{1}{2}$	10	$12\frac{1}{2}$	15
50	$1\frac{1}{4}$	$2\frac{1}{2}$	$3\frac{3}{4}$	5	$6\frac{1}{4}$	$7\frac{1}{2}$
110	$\frac{1}{2}$	$1\frac{1}{4}$	2	$2\frac{1}{4}$	$2\frac{3}{4}$	$3\frac{1}{4}$
220	$\frac{2}{7}$	$\frac{4}{7}$	$\frac{6}{7}$	$1\frac{1}{7}$	$1\frac{5}{7}$	$1\frac{5}{7}$

The lamps referred to are carbon filament.

Supposing, for example, that three Accumulators require charging, each having a current capacity of $\frac{1}{2}$, 1, and 2 ampères, then total charging current is $\frac{1}{2}+1+2=3\frac{1}{2}$ ampères, and assuming that the voltage of Dynamo

or supply is 50 volts, find from the table given the nearest current value, which is in this instance 3¾ ampères, and a resistance of 3-16 C.P. 50 volt lamps connected in parallel to be inserted in the circuit. It will then be found, under these conditions, that each cell will automatically take its own correct share of the current, providing they are in good condition. Care must be used so that before any one cell is taken off the circuit the number of lamps be reduced in proportion.

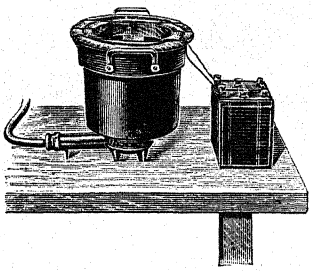
Only charge the cells for the number of ampère hours marked on them, but if the rate is not stated thereon, a safe charging current may be taken as 6 ampères per square foot of positive plate. For example, if there are 3 (positive) plates per cell (each 4 volts Accumulator is made up of 2 volt cells coupled in series), then multiply area of 1 plate in square foot by 3; this will give an area of plates in cell; then multiply by 6, and you will arrive at the safe charging rate in ampères.

Under no circumstances must the cells be discharged below 3·6 volts.

Adaptor for Charging Accumulators.—The particulars as to the Adaptor's use are plainly shown in the illustration.

Care must be used to see the right pole is connected to the right pole of the Accumulator.

The Adaptor is so constructed that by the simple act of placing the



plug in one position the Accumulator is charged, and by placing the plug in the other, a current can be taken from the Accumulator for plating.

We also illustrate how from the Accumulator 2 or 4 Volts can be obtained by altering the connection. This, in most instances, will obviate the necessity of a Resistance Board.

For Gilding, the Accumulator should be connected for 4 Volts, and for Silver-plating, 2 Volts.

POLISHING.

An article which is indifferently polished cannot be made to look perfect by any plater, however clever he may be, because every imperfection left on the article after polishing remains in the same state after electro-plating. Every scratch remaining after polishing is reproduced. It is of the utmost importance to remember that, however the work is polished, whether by hand or by barrelling, as it leaves the polisher, so will it leave the plater, and no amount of finishing will eradicate the faults left by the polisher; and whilst many works have been published on the subject of "Plating," we have failed to find any work on "Polishing."

That which we now call "polishing" of metals is an ancient art, and that some of the earlier nations were remarkably clever at the work may

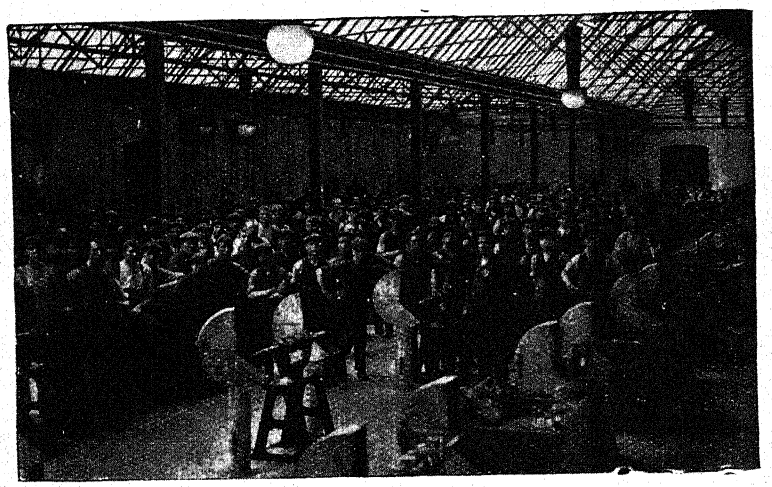


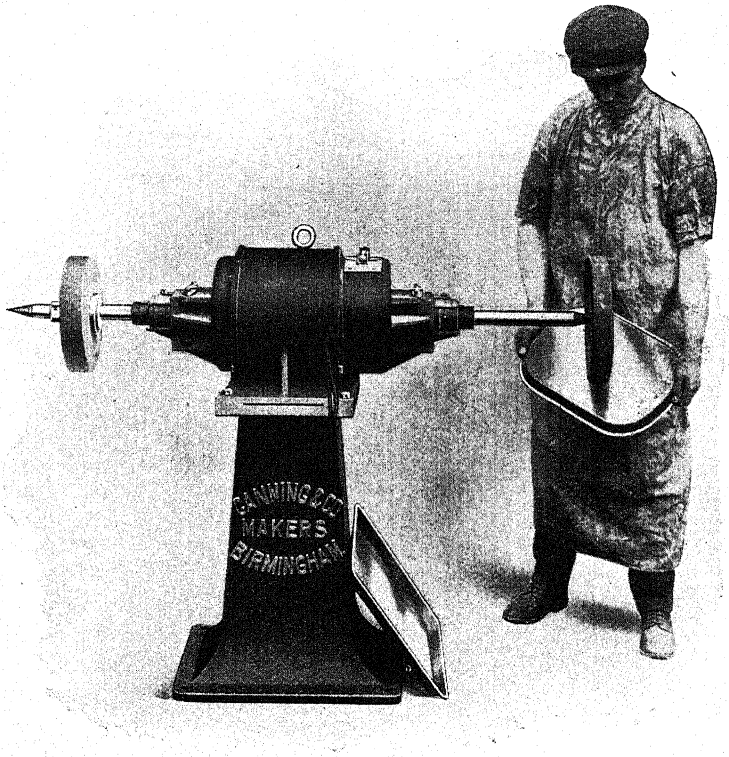
ILLUSTRATION OF POLISHING SHOP, SHOWING CANNING'S POLISHING LATHES.

be determined by specimens of iron and steel work found in our museums, and more particularly the mirrors of bright steel taken from Roman tombs; in the armour and metal work to be seen in ancient houses in this and other countries, and in some of the beautifully finished work of the Asiatics. In the books of the Old Testament we read of "burnished" gold, but we do not meet with the word "polished" in the sense we now use it. We may conclude from the fact of the word "burnished" being used, and that many things are spoken of as "bright," that the earlier work was dependent upon the use of a burnisher for its finish, and that polishing was of later development.

Burnishing is the use of a very smooth tool, which must be harder than the object worked upon. The tool is applied to the object with a certain amount of force; it closes the grain on the surface of the metal, and imparts a smoothness and lustre equal to its own brilliance. The

difference between burnishing and polishing may be briefly described thus : That whilst burnishing produces brilliance by pressing upon or laying flat the surface of the metal, polishing produces it by removing the pro jecting particles.

The spindles, which are 1½ in. diameter, are coupled to the spindle which runs through the centre of the armature of the motor. The motor is two-horse power, suitable for *continuous* current, and is totally enclosed.



ELECTRIC POLISHING MOTOR ON STAND.

The machine illustrated is a self-contained Electric Polishing Motor

The Machine is suitable for running bobs, mops, and brushes of 10 in. diameter, and the speed is arranged accordingly.

It will be readily understood that for work with the precious metals the advantage is with the burnisher, for there is no loss of material, and in the brass and art metal trades it is particularly adapted for relief work. Moreover, gold, silver, and brass are soft metals, and are easily worked upon by burnishers of steel and bloodstone, or any substance which will carry a very hard and smooth surface. Steel or iron requires an excessively hard steel burnisher, and to attain a fine result the process is very slow.

As various classes of steel, iron, brass, and other metals require varied treatment in manipulation, in hardening, etc., so do they require varied treatment in the polishing or grinding.

In ordering an emery wheel, it is necessary that you should specify for what class of work it is required. A wheel may be supplied which in a small factory will, in a way, be useful for a variety of work; but to obtain the most economical result, the wheel should be made for its especial purpose. For instance, a wheel which may be efficient for hardened or case-hardened steel would not work well on common cast iron. So it is with bobs for polishing. Before going into the actual processes of polishing, we will briefly describe some of the materials used.

Emery is a mineral of rare occurrence and very mysterious origin. At some unknown time in the past, and by some means equally unknown, its abrasive qualities were discovered, and to the industrial world its utility has been gradually increasing. As a commercial product, it is comparatively modern. There is no doubt that its greater consumption is due to the increased production of iron and steel, together with that development of power which enables us to attain such high speeds in rotary tools. "An analysis of emery shows a percentage composition of 60 to 80 of alumina, 8 to 33 ferric oxide, with small quantities of lime and water—really an impure sapphire. It occurs in amorphous masses in schists, gneiss, granular limestone, and other crystalline rocks, in rolled and detachable pieces, and in granules and soils." It is found in many parts of the world, but the best comes from the Grecian Archipelago. It is not found in large masses, so that it may be quarried like stone, but amongst other rocks, and sometimes in lumps on the surface. It is carried or carted to the coast, and there it is selected, divided into grades of different qualities, and shipped to various points of destination for crushing.

Corundum is of similar formation to emery, but somewhat harder; but it does not follow that its abrasive qualities are greater, and experiments have proved that for the purpose of which we are now treating, emery retains its supremacy.

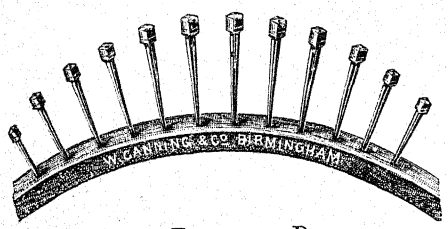
It must be understood that we are writing of abrasives as referring to polishing, not emery grinding, as for grinding purposes corundum, in the form of wheels, has the advantage when used for tools and weapons, inasmuch as it does not raise the temperature of the object so much at emery. In polishing steel or iron, emery is preferable. The amount of metal to be removed is slight, and there is no fear of tempering the object.

Any material used as an abrasive should not be hard in the sense that it will not break. A well-made emery bob is really a continuous file of irregular teeth, yet of even cut, but with this difference: a tooth in a well-cut file, when new, presents a sharply defined acute angle to its work, and when the extreme point is worn away, it still presents an acute angle, although the top of the tooth is flat. With emery, however, when the sharp point which constitutes its cutting edge becomes worn, it should break into more fresh points, otherwise an obtuse angle without any

cutting power would remain, and the effect would be merely to scratch or rub the work.

The covering of a wooden bob with leather should be carefully done. Many a serious accident has been caused by the separation of the leather from the wood stock when revolving rapidly, but if care and good materials are used, accidents will rarely occur. In investigating such accidents, it is sometimes found that the leather covering has been put on with bad or improperly prepared glue. Sometimes it has happened that in turning the face of the bob, the very primitive tool which some of the men will use—viz., a file tang—has broken the leather from the wood at the point where the ends of the strips meet. Should such breakage take place, it is not many seconds before the centrifugal force strips off another foot or two, and the workman receives a very nasty smack in the face.

We cannot too strongly advise a periodical inspection of covered bobs. Do not put a bob on the lathe time after time without examination. We will take a case which might easily occur. By some means—it might be from a leaking roof—the water trickles on to the bob, a few inches of the leather covering on the bob becoming soaked. At that point, the glue will lose its grip, and the leather be dried, but there would be no adhesion between the leather and wood. Next time the bob is used, the pressure put upon the leather will cause it to expand at the defective place, and when worked for some little time, it will gradually break away from the wood. When it reached a joint away would fly the strip, and a serious accident might follow.



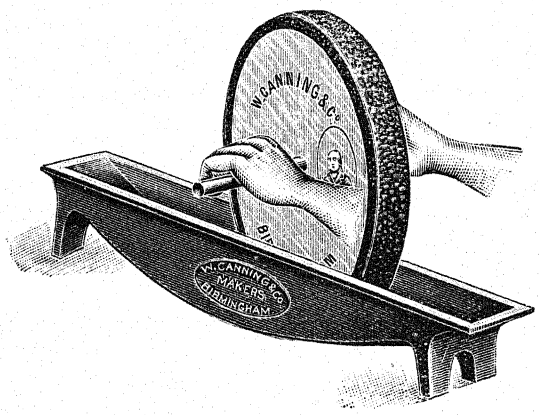
Steel Tacks for Bobs.

The points to be observed in covering a bob with leather are that wood and leather are hot, or certainly warm; use best glue, and apply to a few inches only at one time; tack one end of strip of leather, stretch it to limit, and hammer well to the wood. Wood pegs render the joint more secure, and are no disadvantage when the leather is covered with emery; give the bob ample time to set before turning.

Do not attempt to dress bobs with glue so thick that it leaves a string from the glue-pot to the bob and back again. Such glue could not possibly make a good bob, for the reason that in a well-made bob the emery should be embedded in the glue, not just held at one point. The emery is a crystal or star, and cannot dovetail itself into the glue, and an unsuitable, in fact any, glue of too thick a consistency will not allow the emery to get into its place; and, what is equally important, it will not admit the particles of emery in quantity sufficient to make a compact and fairly solid mass, particles of which not only support each other, but leave so little glue unattached that none of it appears at the surface. So much for the glue; but there is another and very important factor in

making a successful bob. Do not allow the glue to *boil;* use it hot and liquid. At boiling-point glue deteriorates, and as animal matter, such as leather and wool, will not withstand boiling water, it must damage the surface of the bob. Again, the emery is usually kept in a wooden trough, and without any means of heating it. Yet it should be at least the same, or, better, of a higher, temperature than the glue. If the emery is colder than the glue, only the points of the crystals are caught, the glue is immediately chilled, condensation takes place, and bubbles of gas are formed around the particles of emery; and, however much the bob may be pressed into the emery in bulk, the particles are not held in that rigid manner which is necessary to ensure long life to the bob.

A simple utensil for warming the emery is a cast-iron trough about 24 ins. long, 6 ins. wide, 2 ins. deep. A small Bunsen burner underneath



EMERY TROUGH FOR DRESSING BOBS.

will raise and maintain the temperature of the emery. On a finely dressed emery bob for the process called "grease-bobbing," or glazing, "Albo" grease, in the form of a specially prepared block, should be used on the surface. As this greasy matter finds its way to the leather or felt the adhesive power of the glue used in the next dressing would be greatly reduced. To prevent any failure of the glue, a little powdered or slaked Sheffield lime should be rubbed on the surface of the bob before re-dressing.

The speed of polishing spindles is an item which requires attention. Users have sometimes said that felt bobs and mops have been so made that the central portions have contained an inferior material. They have brought forward work done by that part of the tool, and it compared very badly with work which was done on the tool when first used. But the material was not at fault. It was the surface speed which was wrong. The tools, when 15 ins. diameter, had been used on the same spindle,

and at the same speed, until reduced to 8 ins. diameter, and at that size the surface speed was too low to be effective. It is, therefore, advisable that in every polishing shop there should be some spindles running at high speeds. It may be taken as a rule that for effective work the minimum speed should equal 5,000 surface feet per minute.

Having so far dealt with the tools, we arrive at the question of how to use them. Only actual experience can serve here in the manipulation of the work when polishing. To hold the object in that way which will prevent its flight across the shop or through the roof can only be learnt by actual experience. To watch the process of the polishing, so that a defect in the surface of the object is detected, and a little more pressure applied to that particular part, and yet to leave no appreciably hollow place, is what experience alone can teach. It is here we are baffled in the application of automatic machinery for polishing purposes. It is comparatively easy to make a machine to automatically grind an even surface, but when it approaches polishing, or getting up a lustre, the machine would require eyes.

TO REMOVE OLD EMERY.

DAMP the surface with a piece of rag and warm water, and scrape the Emery off as it becomes loose. The least possible amount of moisture should be applied, so as not to damage the covering or loosen the glue which holds it.

Another method which is sometimes adopted—which, however, we strongly condemn and disapprove—is to coat the wheel overnight with grindstone swarf or damp sand, when the Emery should be easily removed next morning ; but do not wet the sides of the wheel or allow any moisture to run down (see also p. 160).

DUST REMOVING.

THE dust and fumes given off in plating and polishing shops, and the small particles of material from Emery Bobs and Polishing Mops, should be removed by means of Fans or other exhaust appliances. The dust must be carried away from the face of the worker, so that he only breathes pure air.

The modern method is to catch the dust immediately it is given off, so that it never actually enters the room, and the best practice is to fix hoods over the revolving wheel with connections to a duct, and to fix the Fan which exhausts the dust at the end of this duct.

Where it is impossible to use a hood, great care is necessary in selecting the best position for the Fan. It should always be so arranged that the Fan is on one side of the wheels giving off dust, and the operatives on the other. For example, if there is a machine carrying two large Glazing Wheels, the Fan should be placed at the back of the wheels facing the operator, so that the particles are drawn away from his side of the machine.

We illustrate two polishing shops. One is a well-known Birmingham brass foundry, and the other a well-known cycle works in Coventry (p. 164).

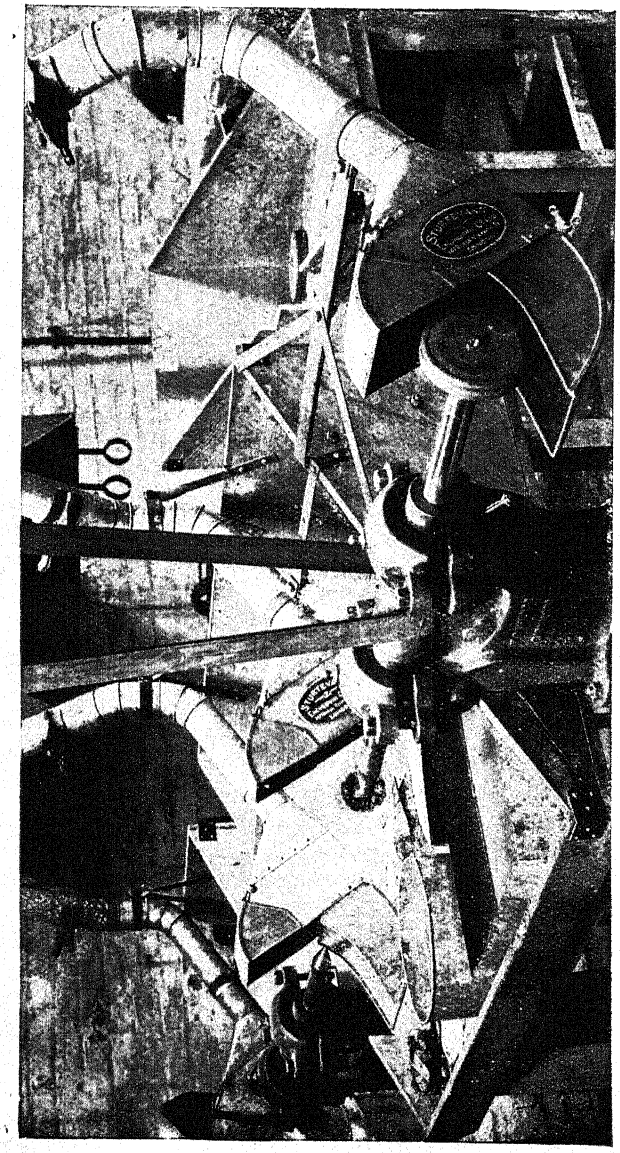
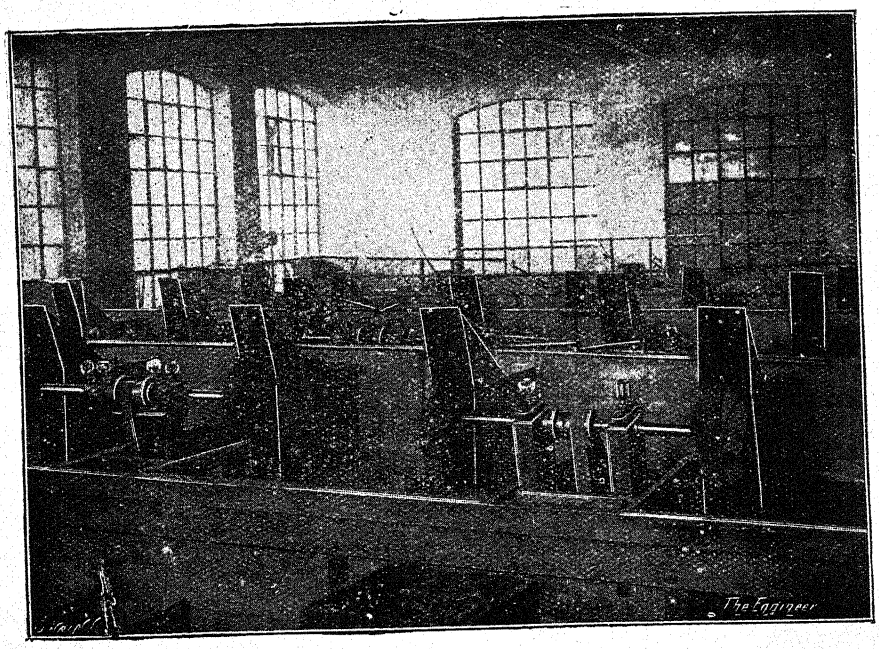
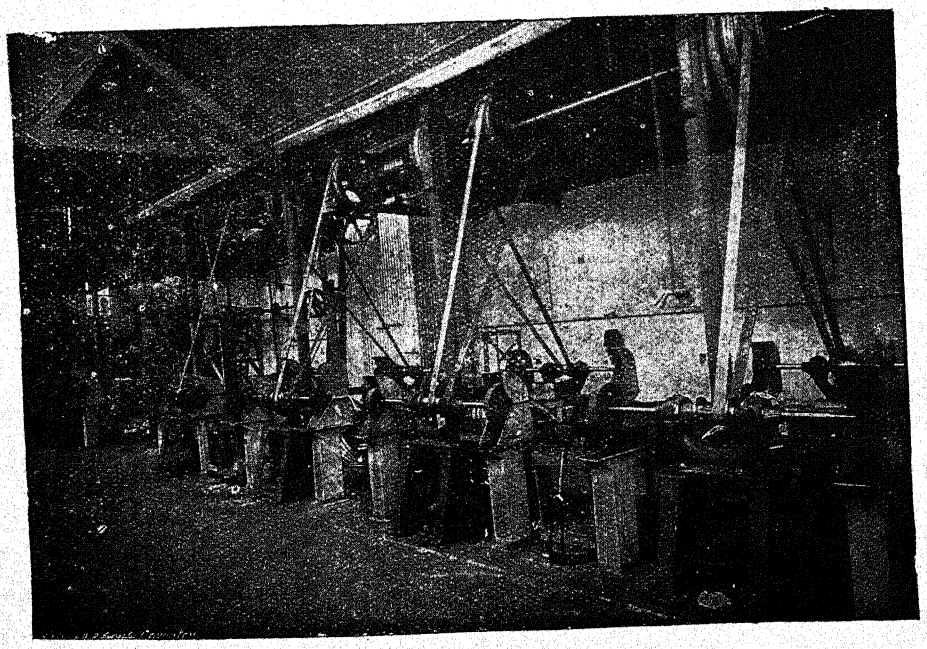


ILLUSTRATION OF DUST-REMOVING OUTFIT.



POLISHING SHOP OF A BIRMINGHAM BRASS FOUNDRY.



POLISHING SHOP OF A COVENTRY CYCLE MANUFACTURING CO.

POLISHING LATHES AND MATERIALS.

Polishing Lathes. These should be thoroughly well made, so that no noise or vibration takes place while running; the speed at which they run depends upon the size of Bob or Mop which is being used, and is given in the chapter on Polishing.

Different pattern Lathes are required for polishing different articles, but Lathes such as 360 P, Q, R, S, V, cover all possible wants for general work; it is not our intention to describe their manufacture in these pages,

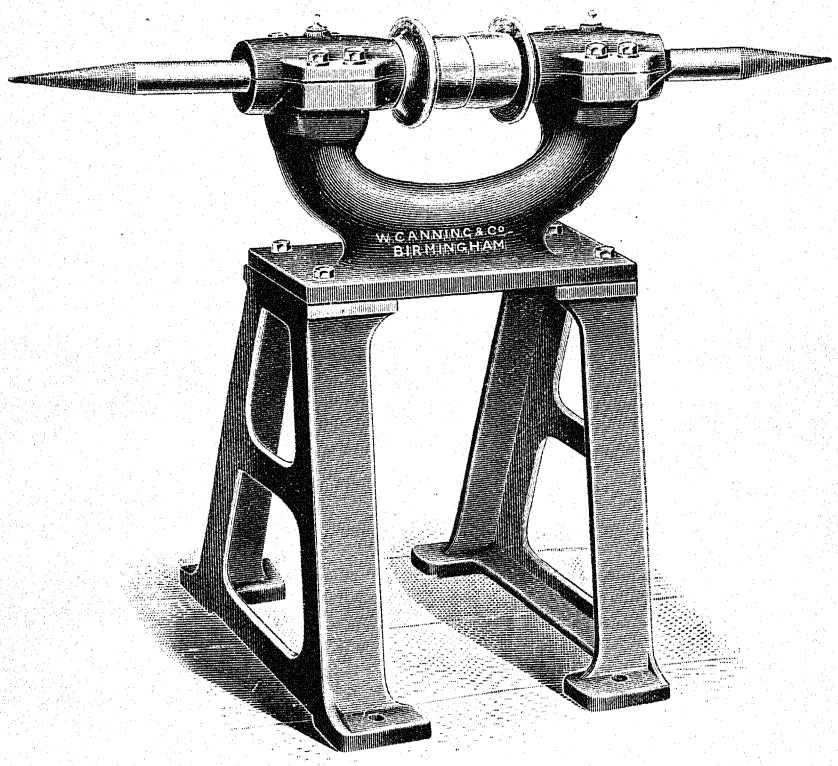


ILLUSTRATION OF COVENTRY PATTERN LATHE, No. 360V, ON LEGS.

as they are fully described in our *Catalogue, No.* 360. The foregoing Lathes are those used for what is known in the trade as "Underhand" Polishing. Particulars of Overhand Polishing Machines will be given later (see p. 208).

We specially bring to your notice our improved design of Polishing Lathes which are fitted with Self-oiling Ring Bearings. They are lubricated with *a ring running in a well of oil and revolving on the shaft.* It is well to remember that a Lathe properly lubricated means less power to drive, thus a saving is effected every hour by using our latest Ring Oil Bearing Lathes.

Ring Oil Bearing Lathe, No. 360, on Stand. The introduction of ring oil lubrication has proved most effective in its application to polishing lathes. It has always been more or less a difficulty to impress upon the operatives the necessity of sufficient lubrication, and even when the oil is applied it often occurs that the covers of the lubricating cups are left open, and in many cases they are broken off, allowing dirt and grit to

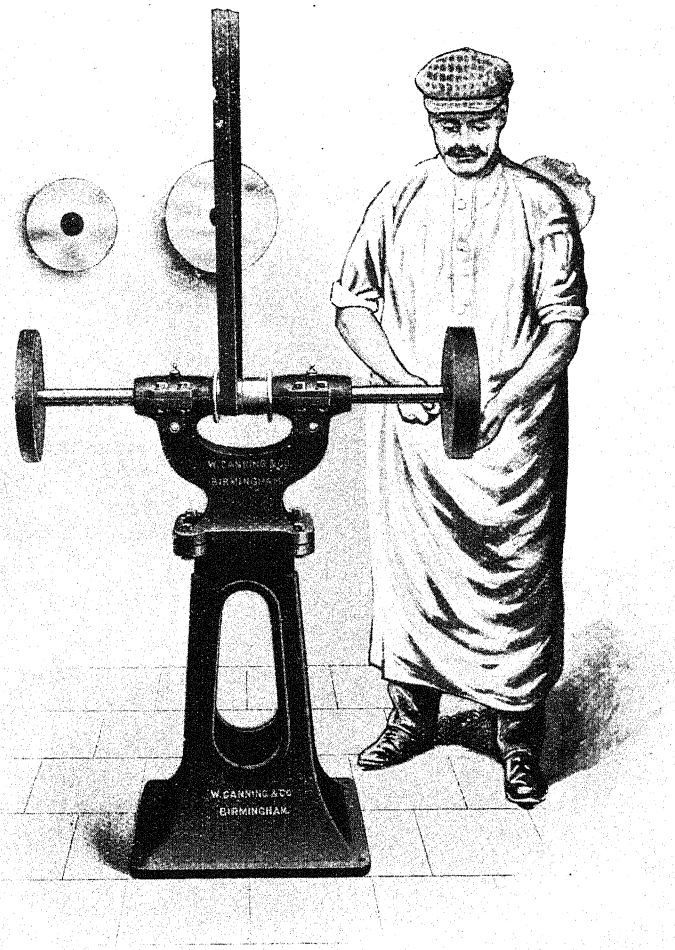


ILLUSTRATION OF RING OIL BEARING LATHE, NO. 360Q, MOUNTED ON IRON STAND.

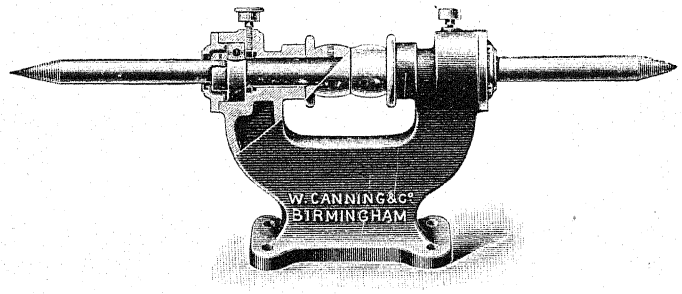
pass into the bearing. This grit and dirt soon destroys the bearing, inasmuch as, when it begins to cut, it makes an open space at each end, and allows a greater quantity of the dust to pass into the bearing. Further, the dust and grit accumulates in the oil cup, and passes with the oil into the bearing. The ring oil bearing avoids all this, as the oil is put into

the oil well through a small hole on top of the bearing. The hole is closed with a screwed plug. The oil well holds a sufficient quantity of oil for many days of continual work. The oil is continually raised from the well to the spindle of the lathe by a ring which revolves loosely on the spindle, and is constantly feeding the bearing whilst the lathe is at work. The oil which is not consumed flows back into the well, from which the oil, when dirty, may be drawn periodically and replaced with fresh clean oil.

The great advantages of this system are self-evident as to economy in the consumption of oil, the easy running and consequently greater life of the lathe, and the fact that the lathe may be run at a great speed without danger of heating.

Canning's Ball-Bearing Polishing Lathes. The application of Ball Bearings to Polishing Lathes has had our attention for a considerable time; we have had Polishing Lathes with Ball Bearings running in factories polishing various classes of work for a considerable period, with the greatest success.

A great saving can be effected by the use of Ball Bearings in Polishing Lathes. Practically no wear takes place. Friction is reduced to an



BALL-BEARING POLISHING LATHE, No. 548.

absolute minimum, and a great saving is effected in oil. Beyond the first charge of grease, they require only an occasional renewal.

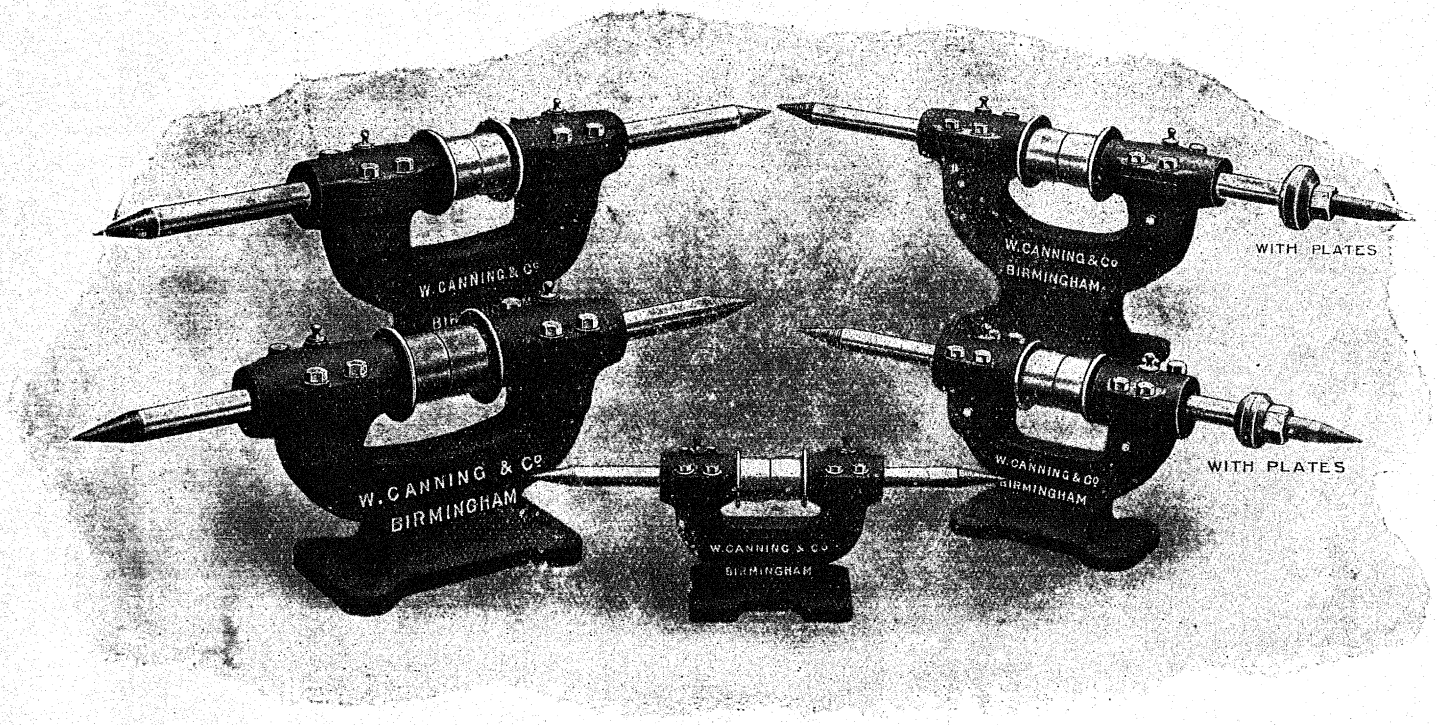
In this application, it is very important to keep the Bearings free from dust, and the very best method is to see that not only the Ball Bearings, but the housings in which they are mounted, are packed up full of grease, and kept full. This protects the Bearings from dirt and moisture.

They are made in all sizes.

In designing our Polishing Machines we have given special attention to the construction, so that they run with the least amount of friction in the Bearings through proper lubrication. The Bearings are long and the spindles are so proportioned as to run rigid with the Bobs or Mops they are constructed to carry.

Choosing a Lathe. The Lathes here illustrated are used for large work, such as polishing Handle Bars for Cycles, Fenders, Hollow-ware, and large articles generally.

These patterns are largely used among Cycle Makers, also universally used among Brass-founders and Hollow-ware Manufacturers for polishing



GROUP OF RING OIL BEARING LATHES.

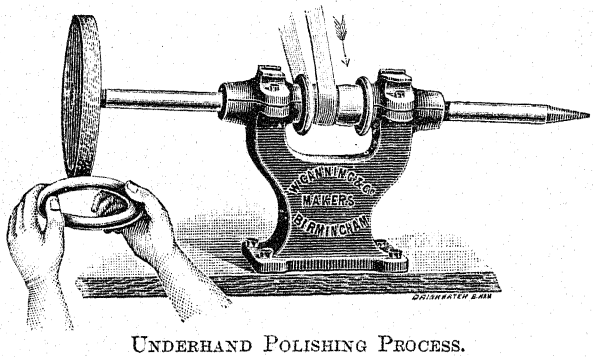
small Brass Work such as Brass Cocks, Brass Work for Furniture, Ship Fittings, Carriage Fittings, Steel Toys, etc., etc.

We give a general illustration (p. 168) of various sizes of Lathes which are used in different trades. The N Lathe (see *Catalogue*) is suitable for polishing Jewellery and any small articles requiring a Mop or Bob not above 6 ins. in diameter.

The O Lathe is also suitable for polishing any article where a Mop or Bob is not required above 9 ins. diameter.

The other Lathes illustrated are suitable for all kinds of work, and we strongly recommend a Lathe with a Spindle of large diameter, as P, Q, R, S, V pattern, with long Bearings, and it is always well to remember a small Bob or Mop can be run on a large Lathe, but a large Mop or Bob cannot be run on a small Lathe.

Plates can be fixed on any Lathe for running Emery Wheels, as illustrated on previous page. For running Emery Wheels, see p. 213.



UNDERHAND POLISHING PROCESS.

Stands or legs are also made to fit any Lathe, and are recommended as a good firm foundation when bolted to the floor.

All Lathes for Underhand Polishing, as illustrated, run towards the Operator, and should be so fixed that the name on Lathe faces the Operator.

Illustration of how to Drive a Polishing Lathe. The illustration (p. 172) shows the different systems of driving Polishing Lathes, which fully describes itself.

The systems A and B are generally adopted in the Birmingham Polishing Shops. The systems C and D are generally adapted for Cycle Polishing and large articles, where the Belt is in the way of the article being polished.

A Fast and Loose Pulley being on the Polishing Lathe, a Countershaft is not required.

Speed of Polishing Lathes. Mops and Bobs should be run at a minimum surface speed of 5,000 feet per minute—*i.e.*, the number of feet per minute a Bob would traverse if wheeled along the surface. Thus, if a 12 ins. Mop or Bob, which has a circumference of, say, 3 feet, is run on a Lathe making 2,000 revolutions per minute, the surface speed of the Mop

or Bob would be, roughly speaking, 6,000 feet per minute (*i.e.*, 2,000 × 3 = 6,000); when the Mop had worn to 8 ins. diameter, the surface speed would be 4,000 feet per minute. As Mops and solid Bobs are usually worn to at least 6 ins. diameter, Lathes should never be run at less than 2,000 revolutions per minute for running a 12 ins. Mop or solid Bob. Lathes with Mops may be run faster than with leather-covered Bobs, as the diameter of the latter remains practically constant in use.

For Jewellers' Lathes, and where small Mops and Bobs of 4 ins. and 6 ins. diameter are generally used, the Lathes should be run at about

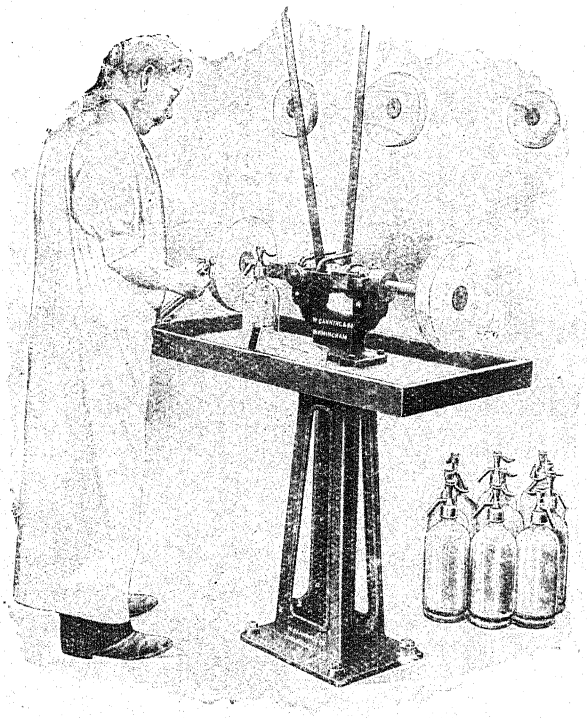


ILLUSTRATION OF POLISHING LATHE, WITH BELT MOVING ARRANGEMENT ON STAND, WITH TABLE.

3,000 revolutions per minute, never less than 2,500. High speed, in all cases, means better results and increased length of life to the Mop or Bob, as the case may be, with less consumption of Compo or Emery, and the speeds should never be less than the minimums given above. **Where large Mops above 12 ins. diameter are used, trouble is often caused, when the Mop has worn to 9 ins. or 10 ins. diameter, through the Mop fraying and the Compo dragging on the work, and the causes of these are in nearly every case owing to the speed being too slow. Where large Mops are used, two or more Lathes should be employed. The Lathes on which**

the large Mop is run should make the requisite number of revolutions suitable for that size, and when the Mop is worn down it should be used on another Lathe running at a greater speed. For illustration, say a Mop 15 ins. diameter is run on a Lathe making 1,600 revolutions per minute, when it has worn down to 12 ins. diameter it should be run on a Lathe making 2,000 revolutions per minute ; when worn to 8 ins. diameter it should be run at 3,000 revolutions per minute.

There is amongst Polishers a diversity of opinion as to the special advantages of the various materials in use, and no doubt experience is the best guide. A description of the materials, with advice as to suitability for particular classes of work, may be useful in assisting the operator in the selection of such materials.

Felt. Felt has many advantages over other materials for certain processes in polishing. The Bobs are perfectly safe in use, as they cannot split, and there is no danger of any portions flying off. They are of even texture, and have no grain beyond that imparted by the tool when turning them, and being of uniform consistency, they present the same even surface at all points of the circumference. They readily absorb the glue, and hold Emery very securely. The best quality is suitable for carrying any size of Emery, and is specially adapted for general cycle work. The superfine quality is of much finer texture, and the wool is more closely felted, consequently the life is greater, and the finer texture renders them suitable for some classes of glazing or finishing.

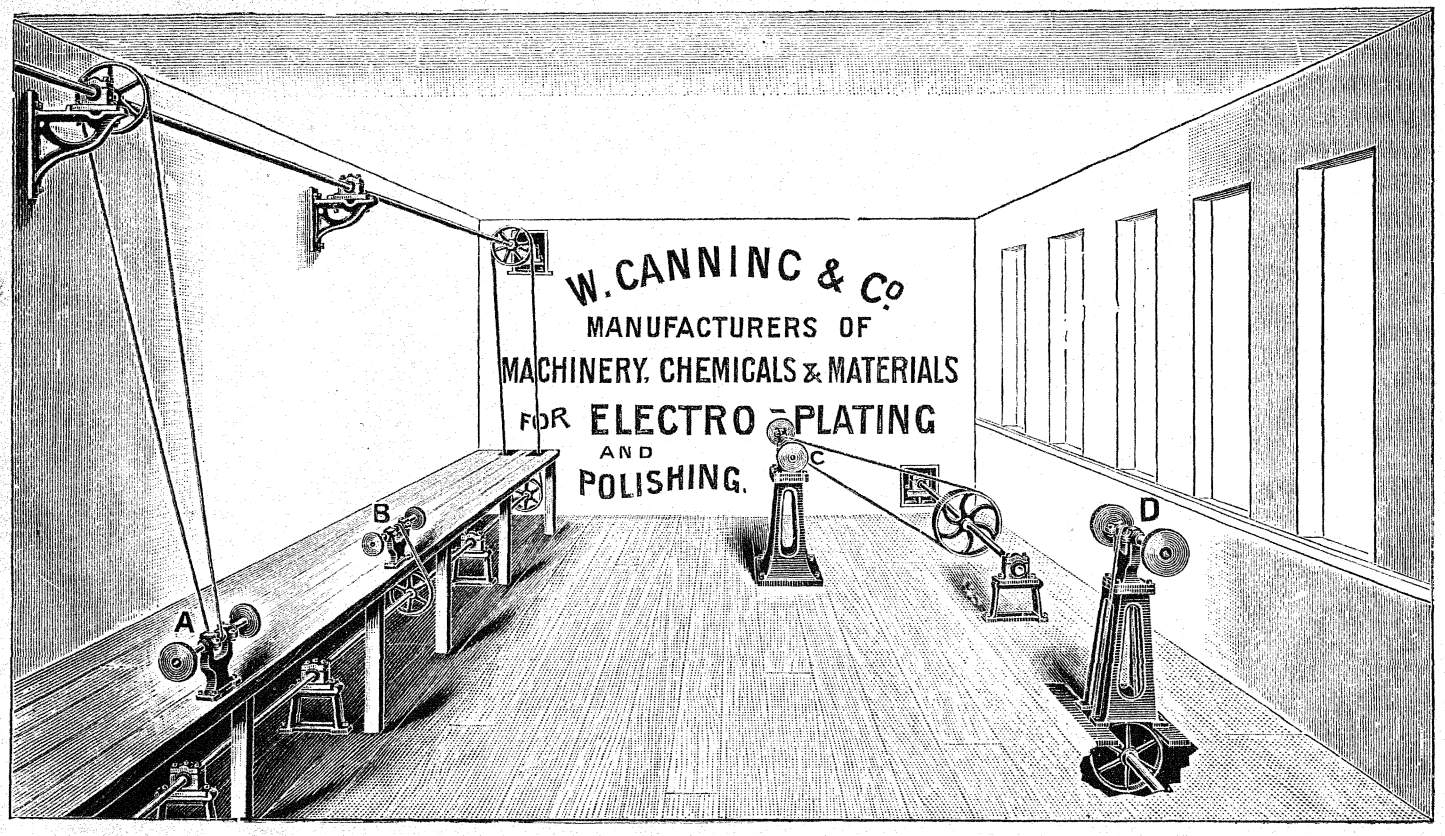
Felt is also exceedingly useful for finishing nickel-plated articles. Used with "Lustre" Polish or Peerless Polish, it produces a fine and even polish on flat surfaces, and where it is desirable that the edges be not rounded by mopping ; also where angles and corners are concerned. As many of the fittings on Motor Cars are of brass, it will be found that a Felt Bob with "Lustre" Polish will produce a bright but soft and machine-like finish, especially on the flat surfaces of such fittings.

Leather. A Leather suitable for polishing should possess a fibrous texture, more or less open as required for its particular use, and research and trials, with special care and attention to the tannage, have brought several classes of Leather into general use for this purpose.

Bullneck. Amongst these, "Bullneck" is possibly the best known. This Leather has a spongy appearance, is of open texture, and a valuable medium for carrying abrasives. It is a good absorbent of glue, and is capable of holding particles of sand, as used for brass polishing, without the aid of glue. The sand is held against the surface of the Bob, and it passes over the object (see p. 184). This leather is of varying thickness and quality, and is equally valuable as a solid Bob, or in strips for covering a wood centre.

For polishing Brass, Copper, or German Silver work, this Leather is strongly recommended.

For some classes of work, the Leather is used in its soft state as it leaves the tanning process, but for sanding and grease Bobbing it is used in a harder state. This hardness is obtained by a process of rolling, which,



Illustrating Different Systems of Driving a Polishing Lathe (see p. 169).

without destroying its absorbent qualities, renders it *harder* and less spongy.

Buffalo Hide is a Leather similar in texture to Bullneck, but of a finer and closer texture. For grease Bobbing and glazing, this is a most suitable Leather, of good wearing qualities. It carries a very even surface, and is particularly recommended for cycle work, for covering large Bobs for engineer's work, polishing hinges, flat-irons, etc., etc.

Seahorse, or "Walrus Hide," is a Leather quite as fine in its fibre as "Bullneck" or "Buffalo," but more open in its grain or texture. This quality of open grain renders it particularly adapted for roughing purposes, as it will hold or grip corn Emery of any size. This Leather may be said to be homogeneous, having no direction of grain, and a piece cut from the hide as a solid Bob would work in same manner as a strip placed around a wood stock. It is of varying thickness from $\frac{3}{4}$ in. to $1\frac{1}{2}$ ins., and Bobs made from the thicker sizes are exceedingly useful and economical tools.

Butt leather is most suitable for Nick Bobs. It is a hard, closely grained Leather.

Spire butt is a hide of special tannage and is most suitable for Emery Bands.

Buff leather has a soft but *very tough* grain; it will readily absorb glue and fine Emery. This absorbent quality makes it most efficient as a glazing or finishing Bob. A most effective tool may be made by covering a wood centre with bullneck or buffalo leather, and covering that with a strip of Buff Leather. Soldiers' Belts, which are made of selected Buff Leather, make exceptionally fine Bobs. The continual dressings which they receive when in use as belts render them very firm and close, and improve the special quality of the Leather for polishing purposes.

Basil leather of soft tannage and dressing is used in the form of Mops. These Mops are useful and effective for sanding wrought brass and copper work, and are also good for finishing purposes.

As already inferred, there is no rigid rule as to the use of materials in polishing; it is a matter of selection; but our experience has taught us that we may generally advise as follows:—

For "cutting out," or roughing purposes, Felt Bobs or solid Bobs of Seahorse, or wood centres coveredwith Strip Felt or Seahorse, are most suitable.

For finishing, superfine Felt Bobs, or wood centres covered with hard rolled Buffalo Hide, are the best adapted; whilst for glazing (or very fine finish) a Bob covered with Buff Leather cannot be excelled.

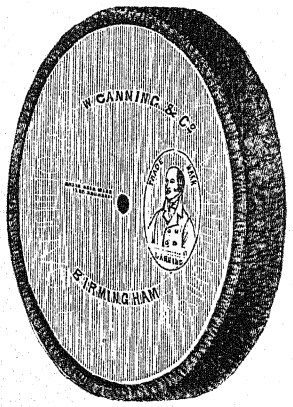
For finishing or glazing tubes, superfine Felt works very well, but it is not so suitable for cranks and any wrought iron or steel article which requires the last finish, or last process in Bobbing, to be taken in the same direction as the grain of the metal.

Brass Work. For polishing Copper, Brass, and German Silver work, Bullneck Bobs used with Trent Sand or with Felt Bobs and Emery are most effective. For wrought, ornamental, and relief work, Basil Mops are useful for sanding and for finishing. Good Polishing Mops used with "Lustre" Polish will always produce a very fine effect.

Materials used for Polishing. The processes of Sandblasting, Pickling, and Shaking will be described later, our preparations now applying to work fresh from the fitting shops. The first process is grinding the article with Emery to the desired fineness on a Leather or Felt Bob, and finishing finally with a Circular Brush and very fine Emery.

Felt (*Catalogue, No.* 464) is made in two qualities, Crown and Superfine. The Crown, which is most used, is made in three grades—Soft, Medium, and Hard. Hard is exclusively used for Sanding, and the Soft and Medium for Emery Bobbing, according to the preference of the user. The soft has greater resilience, and gives to the work better and cuts finer, but is less durable than the Medium. The Superfine, which is only made in one grade, is considerably firmer than the Crown Soft, cuts fine, holds the Emery well, and is very durable.

To cover a Wooden Bob with Leather or Felt (*Catalogue, Nos.* 446, 451). The wooden centres (*Catalogue, No.* 489) must be perfectly seasoned. The woods are made in two or more sections, with the grain of each section at right angles to the adjoining section, and the two firmly cemented together with best Glue under great pressure. The Bob being selected, it should be turned on the face with a sharp chisel with several small V-shape indents. This is to obtain a larger surface for the Glue. In cutting the Leather into strips care should be taken to cut it with the grain, and not across it.



LEATHER-COVERED BOB.

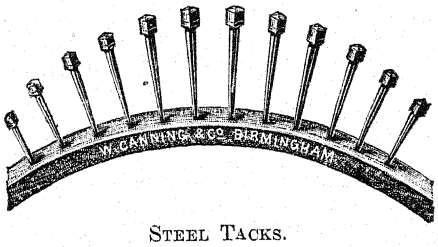
The Leather being selected, the hair side should be filed or scraped to remove the outside grey coating. The Leather should then be nicked with a sharp knife across the strip to facilitate bending and give grip for the Glue.

The Glue (*Catalogue, No.* 494) necessarily must be of a good quality, in thin, transparent cakes. This Glue requires special attention, and will take up a very large quantity of water. The Glue-pot (*Catalogue, No.* 492) must be well heated, but the Glue in the Pot must not be allowed to boil, and sufficient water must be added to the Glue so that when heated it is about the consistency of milk. If thicker than this the Leather will not be held securely, and, when covering with Emery, the Bob will glaze and not CUT when in use.

The Glue should be soaked in cold water for about 4 hours, and then put into the Glue-pot, using only the water it has soaked up.

The Wooden Centre placed in a Vice. The Glue prepared and the Leather ready, one end of the latter is securely fixed to the Wooden Centre with Steel Tacks (*Catalogue, No.* 496). The other end of the Leather is taken in hand with pliers, as it is essential that the Leather be stretched well. Glue is brushed well on the Wooden Centre, and the Leather strip and the Leather pulled down well, hammered down on

the Wood, and the Tacks driven in to secure it. Joints in the Leather should be brought up square together and well glued. The Bob must be put on one side for 12 hours at an ordinary temperature, and not artificial heat, for the Glue to set thoroughly; the Steel Tacks are taken out, and Wooden Pegs (*Catalogue, No.* 497) dipped in Glue hammered in their place, and the Glue allowed to set.



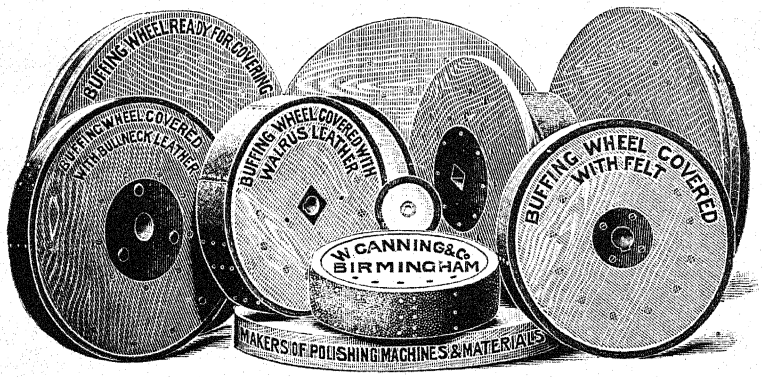
STEEL TACKS.

The face of the Bob can now be turned up true with a sharp chisel, and will be ready for dressing with Emery.

The Wood Pegs mentioned above should not be used with small Bobs for Jewellery or Sanding Brass articles and other fine work, as they are liable to scratch. Some steel and iron polishers object to them on this score, but it is doubtful if their presence in a large Bob is detrimental, and they are a decided advantage in securing the Leather.

Holes of any size can be made in the wooden centre of all these Bobs, either for running on the screwed end of the spindle or between plates.

Bobs of 18 ins. diameter or more are used in heavy trades for overhand work. These Bobs are not mounted on a taper screw, but are



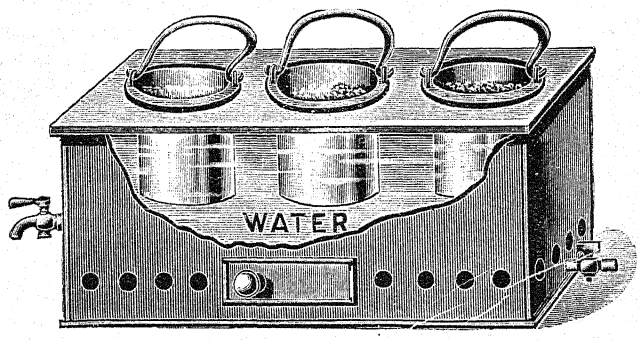
OVERHAND BOBS.

either keyed on the spindle, or more usually screwed between plates on the spindle. Iron Plates or Bushes are usually fixed in the centre of the Bob.

The Bobs are built up of sections, the same as the smaller ones, and never made of one piece of wood. These large Bobs are usually covered with Felt or Thick Seahorse Leather (*Catalogue, No.* 475), as Bullneck is too thin and the Bob would require re-covering too frequently. The operations are carried out exactly as described for Bullneck on the smaller

Bobs, and the same way with Felt, except that it is advisable to steam the *Felt* if too hard or too thick to bend easily.

Covering Bobs with Emery. The process here described applies equally well to Leather or Felt Bobs and to Emery Bands. It is usual



GLUE-POT HEATER.

to commence the grinding with Nos. 60 or 70 Emery, the next operation requiring Nos. 80 or 90 Emery, and the next No. 120 Emery, with some polishers using still finer Emery in No. 140. Each grade of Emery requires a different Bob, and more Bobs are required with the fine

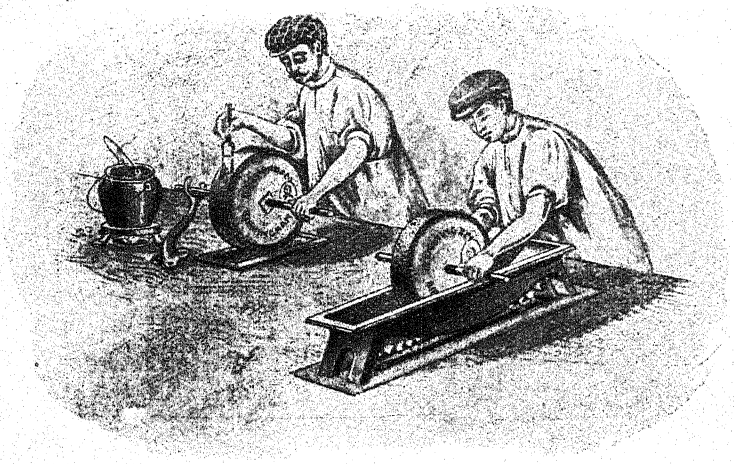


ILLUSTRATION SHOWING METHOD OF DRESSING BOBS.

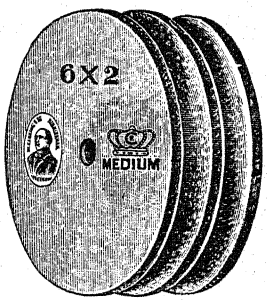
Emery than the rough. Each polisher usually requires an assort ment of about 20 Bobs.

Too much care cannot be devoted to this coating of Emery, as upon such care expended depends the cutting power of the Emery and the length

of time it will last before recoating. The glue must not be thick and like treacle, but just as previously described. The Emery should be heated in a pan. The glue being applied to the Bob, the Bob should be taken in hand with a rod through its centre and rolled or bumped in the warm Emery. If the Emery is cold, it chills the warm glue, or if the glue is thick, the grain of Emery, instead of sinking right into the Bob and fixing itself securely, remains only on the surface of the Bob, and immediately the Bob is used, instead of the Emery cutting, it is rubbed off, and the whole surface of the Bob becomes glazed, with no cutting power.

The Bob covered, any inequalities on the face are usually regulated by holding a large pebble or piece of Lump Pumice to the face before commencing grinding.

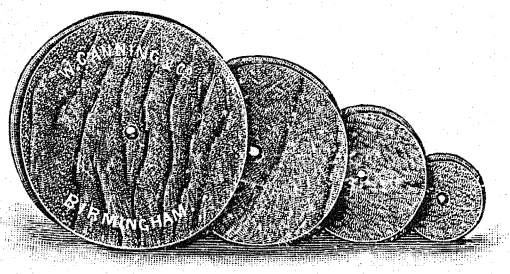
In polishing, the rough Bob removes the coarse file-marks and other indents left on the work; but in all cases care has to be taken to remove no more than is necessary from the article.



FELT BOB GROOVED.

In Emery Bobbing tubular work, Felt and Leather Bobs are usually employed, and their faces grooved to enable the tube to be worked freely lengthwise on the face of the Bob. This particularly applies to Cycle Frames preparatory to enamelling, also to handle bars and Motor-Car Parts.

Solid Leather Bobs (*Catalogue, Nos.* 468, 470). For Cold drawn tubes, machined Cranks, and similar classes of work, Bobs dressed with No. 120 Emery are sufficiently rough for first process. If coarser Emery is used, it makes cuts or indentations which require more time to remove than the original surface of the work demanded. The grinding of articles having nicks and crevices requires the use of solid Bullneck Bobs for the Cycle and other trades.



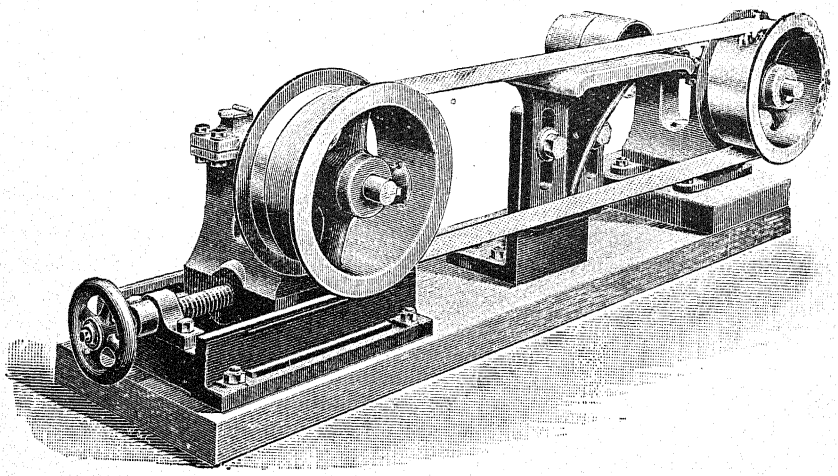
SOLID LEATHER BOBS.

They are cut from the Bullneck in circles, with a centre hole, and turned ready for use. They are covered with Emery in the same manner and used as larger Bobs. They seldom are used above 6 ins. diameter. Nick Bobs for sanding are described later.

Solid Seahorse Bobs are used frequently in the place of Bullneck, as the cut is better and they wear longer. Bobs of great thickness, about $1\frac{1}{2}$ ins., and in diameter about 6 ins., are much used for tubular work in the place of Small Felt Bobs, which, when used very small, are apt to split. It is increasingly difficult to obtain Seahorse Leather of a greater thickness than $1\frac{1}{4}$ ins., except at almost prohibitive prices, and two Bobs are frequently joined with screws to make up one wide Bob for grooving.

Emery Bands. In various trades Emery Bands are used by polishers for grinding in difficult positions, such as inside of Forks, etc. They are run on some such principle as the one here illustrated (*Catalogue, Nos.* 390 to 392).

The use of these bands is not an increasing one, as it is difficult to get them to stand well up to the work without much sagging. Leather



EMERY BAND MACHINE.

Bands made endless and with no lacing—all joints being cemented—and with as little grease as possible are used, and the Emery put on similarly to the covering of Bobs. Emery Bands ready covered (*Catalogue, No.* 518) are much used, the Emery being fixed on strong webbing. For joining these Tapes, an extra 6 ins. over and above the length required must be provided for. Soak a few inches on one end of the Tape in water for a few moments and scrape away the Emery; lay this scraped portion under the other end and glue together. It is also advisable to glue a piece of calico about 6 ins. long underneath the joint.

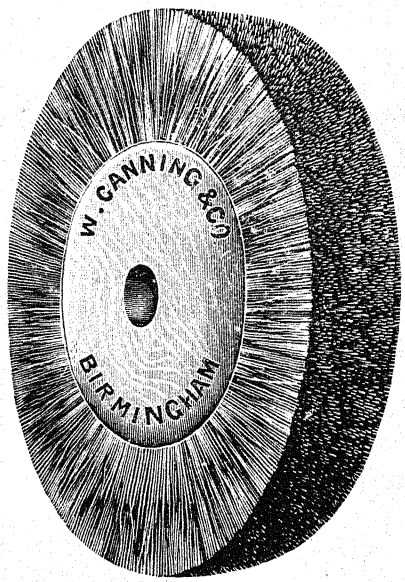
To Remove Old Emery. When it is necessary to re-cover, or rather re-dress, Bobs with Emery, moisten the face of the Bob with lukewarm water, and as the glue softens, remove by scraping with a drawing knife. Never use moist Grindstone-swarf or other moist sandy material for any length of time, as the moisture saturates the leather or covering and

penetrates to the glue underneath. After cleaning, wipe dry before dressing with Emery.

Brushing. After Emery Bobbing, to remove all vestiges of scratches and to impart a finish of minute fineness to iron and steel work, it has to be treated with Canning's Brushing Emery Composition (*Catalogue, No.* 797). The Brushes used (*Catalogue, No.* 596 or 621) are made usually of Fibre material, owing to the expense of Bristles. Brushes made with Fibre alone are used most frequently, but where the very highest finish is required, a Bristle Brush should be used.

Canning's Brushing Emery Composition (*Catalogue, No.* 797). The Composition is held in the hand, and a small quantity is applied to the Brush as it revolves. When all the Emery marks have been removed, the process completed, articles of Iron and Steel so treated are ready to be passed on to the plating shop (see p. 181).

Polishing Mops. These are made in various grades of Cloth (specially made for Polishing) to suit the different metals for which they are used to Polish and Finish. The various kinds are denoted by letters, and will be seen in the chapters describing the manner in which the different metals are polished. They are made in all sizes, from 1 to 18 ins. diameter, for polishing the smallest piece of Jewellery or the largest article made.



CIRCULAR BRUSH. No. 621.

Grades form four divisions :—

White hard mops both open and stitched, for cutting and grease-mopping—that is, polishing before the final finishing.

Brown Mops for finishing ordinary metals.

Swansdown Mops for finishing gold and silver where not burnished, and for finishing best brass and copper.

Basil Mops for colouring Wrought Brass work.

It is of importance that the Mop should be suited to the work; although a certain result may be obtained with a Mop, it may not be the economical one to use. The trend of recent years has been for the quality of Mops to improve, so as to obviate the amount of fluffy cotton in the shops, this being a source of danger through fire, and is also objectionable to the operators. Further, a lasting Mop is one that consumes considerably less Composition than a quick wearer.

The best Mop for **German Silver and Solid Nickel Articles** is our White Quality F (*Catalogue, No.* 429), both for cutting and finishing. This Mop

should also be used for finishing **Nickel-plated Work,** where the deposit has been a good one ; but these Mops cut too quickly for a poor deposit, in which case a Brown Mop, Quality B (*Catalogue, No.* 428), should be used. Quality F should also be used for polishing **Steel Work,** such as Scales.

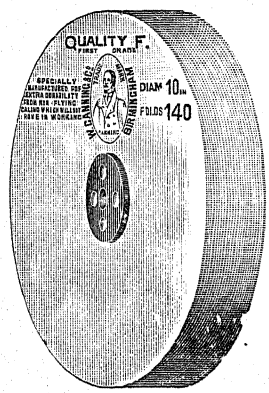
Engineers' Iron Work, such as levers, handles, etc.

Quality F. for Grease Mopping :—

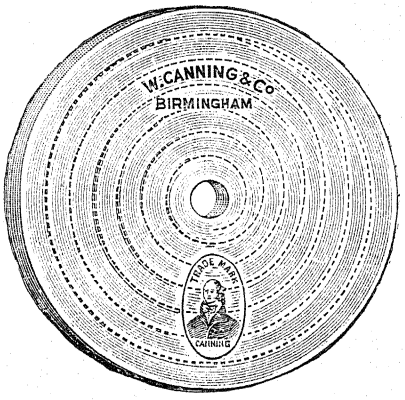
Brass Cock Work, where narrow Mops of hard cutting material are requisite.

For **Brass Work** with rough edges, particularly cabinet work.

The best all-round Mop for finishing is our B Quality (*Catalogue, No.* 428) for **Brass Work** finishing, after grease mopping. Also for



POLISHING MOP.



SPIRAL STITCHED POLISHING MOP.

Nickel-plated Work finishing, where a hard white Mop will remove too much Nickel.

Copper requires for finishing a Soft Mop in brown cloth, Quality G (*Catalogue, No.* 434), or Swansdown (*Catalogue, No.* 431).

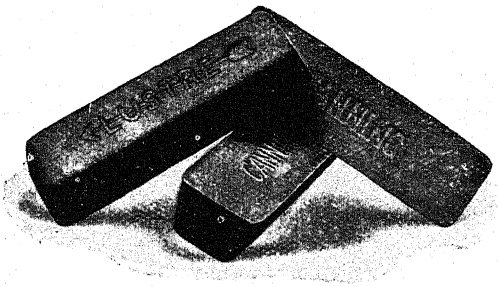
Delicate Brass Work and High Class Bedstead Work require the same class of Mop, also **Silver and Gold.**

Basil Leather Mops are largely used for colouring wrought brass work, and for **relieving copper and brass bronzed work.**

Spiral Stitched Polishing Mops, as illustrated, are used for cutting and polishing Brass Tubes and Brass Work generally, and represent the cheapest form of Mop, but unstitched Mops serve the same purpose more economically. A Machine for polishing Tubes is described later.

POLISHING COMPOSITIONS.

With all the various Mops, Polishing Compositions are used, and these are made of various compounds for the various metals to be polished.



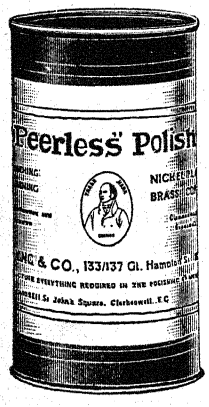
Polishing Composition.

Our "**Lustre**" **Polish** is the best article to use for polishing Brass, German Silver, Copper, Solid Nickel, and similar metals, and for finishing after Nickel-plating.

Crocus Composition is for polishing Tin, Silver, and Steel Articles.

Emery Composition for Brushing, for use on a circular brush in place of Flour Emery and Oil, is specially suitable for Cycle Work, and for procuring a high finish on Steel and Iron articles.

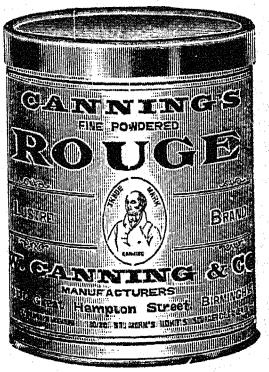
Rouge Composition is specially suitable for finishing Brass, German Silver, Copper, Solid Nickel, Silver, and articles of Jewellery, is strongly recommended for giving the final finish to Brass Tubes, Bedstead and Brass Fender Mounts. The hard Wax Rouge is specially made to clear off well from the Mop and leave the work clean and ready for lacquering.



Peerless Polish. A fine white Finishing Composition specially prepared for finishing Nickel-plated articles in place of Sheffield Lime; also used for finishing German Silver, Brass, Copper, and Steel articles, but is specially suitable for Nickel.

Sheffield and Vienna Lime. These are special Limes used for the finishing of Brass, Copper, German Silver, and Solid Nickel, or Nickel-

plate. They are used dry in the lump, and, owing to their peculiar character, clear off well in the finishing process. A little is generally used for the final finishing of these metals.



The Lime must be kept in air-tight receptacles, as it is spoiled by exposure.

It is well at this point to call attention to the fact that great care should be taken in keeping Lime in Air-tight Drums, and also that the Finishing Shop be kept as clean as possible. Have all Mop Rovings and dirt swept up every night, as small portions of Oil, Calico Rovings, and other material in a Polishing Shop form a highly inflammable combination and material for spontaneous combustion.

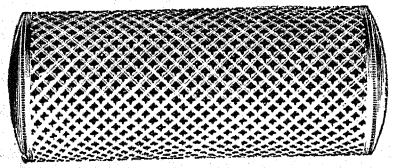
Rouge Powder. This is used in various grades and qualities for procuring the highest finish on Brass, German Silver, Copper, Gold, Silver, and other metal.

Trent Sand is used for Sanding Brass, German Silver, Solid Nickel Copper, Silver, and Cycle work. It is usually supplied to the user sieved and prepared ready for use. It is damped with a good quality mineral oil to prevent it from flying about.

Emery, in grains or powder, is used for polishing nearly every kind of metal, and its use occurs frequently in these pages.

Glue. It is important that glue of the highest quality is used for Gluing Leather to Wooden Centres, and also for Gluing Emery on the Leather. It should be thin. Common quality glue is useless for this purpose.

Notes to be Observed in Polishing. If the Mop becomes clogged with Compo, a Mop Dresser is used, as illustrated, to clean it. The operator holds the Dresser against the Mop as it revolves, till the surface is clean; it can also be used to true the Mop if required.



Mop Dresser.

Leather-covered Bobs used for Sanding Brass, Solid Nickel, Copper, German Silver, or Silver must not have the Leather pegged on with wooden pegs, as they will scratch the articles. Care must be taken to see that the Leather is securely glued to the wood.

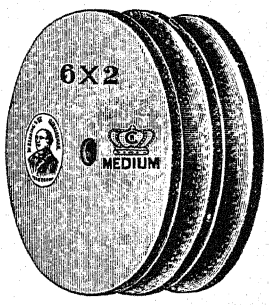
Solid Bullneck, Walrus, Nick Leather, and Felt Bobs can be turned with a sharp tool to any desired shape

POLISHING AND FINISHING CYCLE WORK.

Polishing. Cycle Work, to have a good finish when Nickel-plated, must be well polished in the following manner :—

1st Operation. Handle Bars, Brakework, and all parts which are round, are polished on a Felt Bob of medium grade, revolving at 2,000 revolutions per minute.

The Bob should be 10 or 12 ins. in diameter, 1½ to 2 ins. wide on the face, and for Handle Bars a Bob is sometimes used grooved, as shown in the accompanying illustration.



FELT BOB GROOVED.

The face of the Bob is then covered with No. 90 or 120 Emery, and the articles bobbed all over. The size of Emery is dependent on the condition of the article.

2nd Operation. This is done in exactly the same manner, but with 120 Emery, which is much finer. If work is finely machined, or has a good surface, one operation of 120 is sufficient.

3rd Operation. A Circular Brush (*See* p. 179), is fixed on the Lathe and revolved at about 2,000 revolutions per minute. Canning's Brushing Emery Composition is applied to the Brush, and the articles brushed all over at right angles to the Bob marks until all the latter are removed. The work should now have a good clear surface, and fit to go to the Plating Shop for Plating.


POLISHER'S PINAFORE AND CAP.

Cranks and other parts which have to be kept square and the edges sharp are polished on a Bullneck Leather-covered Bob (*Catalogue, No.* 445), and the same size of Emery used as with the Felt Bobs already described.

For small parts, also crevices and corners, where it is impossible to get a flat-faced Bob, a Solid Bullneck or Seahorse Leather Bob turned up on the face to the desired shape is used, and when used the Corn Emery is damped with a little oil, and allowed to trickle from the palm of the hand, little by little, between the face of the Bob and the article being polished.

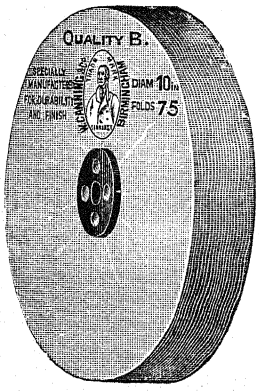
The articles are then brushed, as previously described.

If an extra fine finish is required, a Glazing Bob is used instead of the Brush, made in the following manner :—

A Bullneck Covered Bob has a covering of Buff Leather (*See Catalogue, No.* 447), and on that is put No. 120 or 140 Emery, as before described. As the Bob is revolving a little Bobbing Grease, specially prepared for the purpose, is held against the face of the Bob for a few seconds ;

a round pebble is then held against the face of the Bob until it has a fine and smooth surface to prevent scratching the article. The latter is glazed all over, and is then ready for Plating.

After the parts are plated, they are finished on a good quality (B) Brown Polishing Mop (*Catalogue, No.* 426), 9 ins. to 12 ins. diameter and 1½ ins. to 2 ins. on the face, revolving at a speed of 2,000 to 2,500 revolutions per minute, according to the size of the mop (see page 169); to the Mop is applied a small quantity of Peerless Polish (a special preparation we manufacture for finishing Nickel-plated Work). The polish is held against the Mop as it revolves, when a small quantity of the polish will



adhere to the mop. A small quantity of the Polish must be frequently applied to the Mop as the work proceeds.

Care must be used, in finishing after plating, that the operator does not polish off all the Nickel from the corners, as is often done in the case of unskilled labour.

Smaller Mops will be required for getting in Corners and Nicks, Pedals, etc. They are used in a similar manner to the larger ones.

Small flats, such as on Pedal Pins, etc., may be effectively finished by using a small felt Bob to which some Lustre Polish has been applied.

POLISHING BRASS WORK.

ARTICLES made of Cast Brass are polished by a different method to those of Stamped Brass.

Cast Articles. *1st Operation.* When the article comes from the casters, it is dressed on Emery Wheels or a Disc Grinding Machine (see chapter on these later). It is then sanded in the following manner:—

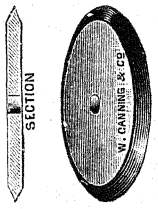
2nd Operation. A Wood Bob, covered with hard Bullneck Leather, about 10 ins. diameter and 1½ ins. on the face, revolving at 2,000 revolutions per minute, should be used in connection with Trent Sand.

The Trent Sand, sieved very fine, is damped with Mineral Oil of

good quality to prevent it flying about, and lies on the bench (preferably in a shallow wooden tray). The operator takes a little sand in the palm of one hand and the article in the other, and allows the sand to trickle down, little by little, between the article being polished and the face of the Bob, till the former is sanded all over, and all the rough casting or file-marks are removed.

In the nicks or crevices where it is impossible to get a Bob with a flat face, a Nick Bob, as illustrated, is used (*See Catalogue, No.* 472).

Also solid Seahorse Bobs (*Catalogue, No.* 469) and Solid Bullneck Bobs (*Catalogue, No.* 477) are used, as before described in connection with the sand, for articles of different shapes, as it is impossible to adapt one Bob to the numerous different articles to be polished.



NICK BOB.

Another method is to use Emery, glued on the face of a medium or soft Felt Bob, and this method is strongly recommended. If this method is adopted, refer to the chapter on Polishing Cycle Work, as it is carried on in the same way, using Emery No. 120 in the place of sand.

3rd Operation. After the work has been sanded, or what is called "grease mopped," it is polished on a Cloth Mop, made of F quality Cloth, about 12 ins. diameter and 1½ ins. on face, revolving on the Polishing Lathe at 2,000 revolutions per minute. In connection with the Mop, "Lustre" Polish is used. Take a bar of the Polish and hold it against the face of the Mop as it revolves, when a little will adhere, and a further quantity must be applied from time to time as required.

4th Operation. This is the finishing process, and a Mop made of B quality Cloth is used, size and diameter as F Mop, used in 3rd operation; Rouge Composition, Quality B, is applied to the face of the Mop, as before described, and the article should have a beautiful lustre.

Sometimes Peerless Polish, or Sheffield Lime (lump in the dry state), is used in place of Rouge Composition in the same way, sometimes a little Powdered Rouge, Quality B, mixed into a paste with water or Methylated Spirits, put on the face of the Mop with a stick from time to time as required.

In all cases the size of Mop or Bob must be determined by the article being operated upon.

In some instances, where it is impossible to get a Bob for sanding Brass Cast articles, a Brush, No. 596, or a Basil Mop, according to the size of the articles, is used, and the sand is mixed with mineral oil into a thick paste, and the article brushed.

After the article has been fully polished it is usually washed out in Petroleum with a soft Scouring-brush (see No. 598). The article is dipped in Petroleum, brushed, and then well dried in boxwood sawdust, which should be in a Pan provided for the purpose in the Polishing Shop.

We recommend Methylated Spirits in place of Petroleum, as it cleans better, is free from grease, and the articles look cleaner. The articles are then ready to go to the Lacquering Room to be Lacquered.

Stamped Brass Articles. After the rough edges have been removed on a Disc Grinding Machine or Emery Wheel, and if the metal has a good surface, the sanding, as described before, may be dispensed with, and only the Mops are used, as described. In some cases Bazil Leather Mops (*See Catalogue, No.* 436) are preferred in place of the B Quality Finishing Mop, but the same composition, etc., is used.

Brass Cocks are sanded with solid leather Bobs of Bullneck and Seahorse, or Emery bobbed with narrow Felt Bobs and finished with narrow Mops and Lustre Polish.

German Silver articles are first immersed in a dilute Sulphuric Acid Solution (1 part Sulphuric Acid, 10 parts Water) for about half an hour,

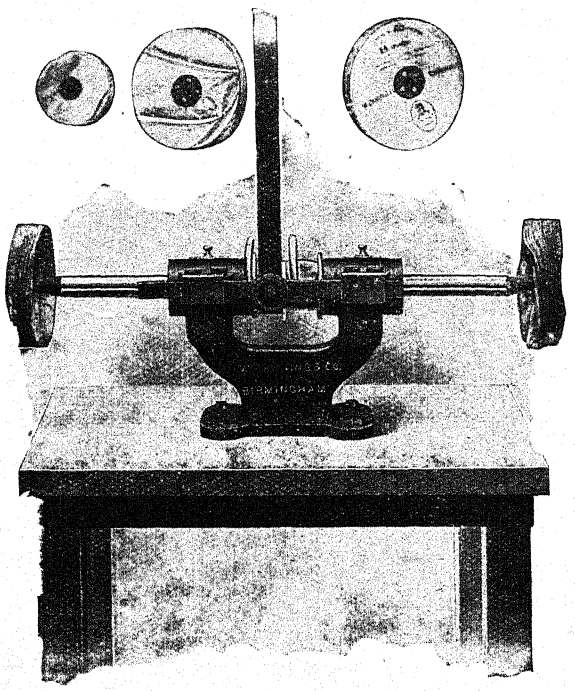


ILLUSTRATION OF POLISHING LATHE, WITH BELT MOVING ARRANGEMENT ON TABLE.

then dipped in Aqua Fortis, and swilled in Water. They are then sanded with Felt or Bullneck Leather Bobs and Glasscutter's Sand in the same manner as described on p. 185, followed by grease mopping with Polishing Mops Quality B and Lustre Polish. They are then finished on Basil Mops with Peerless Polish, and are ready for Plating.

Spoons and Forks, from the stampings, are first edged with solid Emery Wheels, and very narrow Emery Wheels are necessary to get between the prongs of the Forks. The stampings are then sanded with very small Leather or Felt Bobs.

The "insiding" leather for bowls of spoons is required hard.

"Stringing-out" Bobs of about 10 to 12 ins. diameter of hard narrow leather are used for sanding the prongs of Forks.

The finishing is accomplished with small Mops and Lustre Polish and Rouge Powder.

Bedstead Tubes are polished on ordinary Polishing Lathes or by special machines, as fully described on p. 188.

Spun Articles in Brass, such as Mounts, etc., if of a cheap class, is frequently finished straight away on a Brown Mop and Rouge Composition, without the Grease Mopping with Lustre Polish.

Polishing Old Brass. After the lacquer has been removed, by boiling the article in "Lyco," swill and dry in sawdust. If the surface is clear it will not require sanding, but if the article is eaten away by exposure, it will have to be sanded to get a good surface, then polished on the Polishing Mop, as before described.

Polishing Cast or Rolled German Silver, Solid Nickel, or Copper Articles. The above are polished with the same material as is used for polishing Brass, therefore the same instructions will apply (see p. 184).

Britannia Metal and Pewter. The polishing of the above is done similar to Cast Brass articles (see p. 184). The article is first sanded, but Soft Leather is employed, and then mopped on a C Quality Mop with Lustre Polish, and if a very fine finish is required it is finished on a Swansdown Mop and Rouge Powder, Quality B.

Polishing Cast Iron Articles. Such articles as Castor Horns, small parts of Stoves, Lamps, and articles of that description, are first dressed on an Emery Wheel to remove all the lumps from the castings, and afterwards polished on Bullneck Covered or Felt Bobs, as described in article on Polishing Cycle Work. The size of Emery used depends on the condition of the castings, but usually No. 60 on the first Bob, followed by No. 90, then No. 120; and, if a very fine finish is required, the articles should be brushed or glazed, as described in article on Cycle Work.

Polishing Celluloid and Xylonite. The article should first be polished with a Brown Cloth Mop (Quality B) in conjunction with fine Powdered Pumice well moistened with Water to make it adhesive.

The wet Pumice is allowed to trickle from the hand, between the article and the Mop, as the latter revolves. The article is then polished with another Mop (Quality B) and Lustre Polish and a light touch of Albo Grease.

The article is then finished on a Soft Brown Cloth Mop (Quality G), applying to the face of the Mop a little Vonite.

Coloured Celluloid and Xylonite. The same process is followed with coloured articles, with the exception that in the second process Rottonstone is used in place of Lustre Polish and Albo Grease.

Polishing Vulcanite Rod. Great care must be taken in polishing that too much heat is not developed to cause the Vulcanite to fire. The Vulcanite Rod is first rubbed down by hand with Emery Cloth to remove any lumps on the surface.

A " Canno " Felt Disc Mop, 18 to 20 ins. diameter, is next used, with Pumice Powder well moistened with Water to produce a fine finish to the Rod. On another " Canno " Felt Disc Mop the process is continued, Spplying Paraffin Wax to the surface of the Disc, then a little Rottonstone. The final finish is gained by using a dry Polishing Mop (Quality B) or a awansdown Mop.

Polishing Vulcanite—Flat or Block. The Flat or Block article is first ground on an Emery Disc Grinder or Emery Wheel. A Felt Bob " Crown " Brand Soft is then used, glued to a wooden chuck, so that the Bob can be used on the side. Moistened Pumice Powder is used as the polishing medium in conjunction with the Felt Bob.

A finer surface is next obtained by using another Felt Bob in the manner just described, using a little Tellurine Powder mixed with Oil. The final finish is accomplished by using a Brown Polishing Mop (Quality B), or a Swansdown Mop, with Lustre Polish.

TUBE POLISHING.

Roughing or Scouring. The Roughing or Scouring process of round and square Tubes is carried out as follows:—

Wood Bobs, size usually 10 × 2 ins., covered with hard Bullneck Leather, in conjunction with Powdered Pumice and Prepared Trent Sand in equal proportions. Felt Bobs, " Crown " Medium Brand, are next used with Prepared Trent Sand alone. The Tube is polished *under* the Bob, and a Rest is placed at the back of the Lathe to steady the Tube. The next process is:—

Grease Mopping. Brown Polishing Mops, Quality B or E, with Lustre Polish, are used, the Polishing Spindle revolving at a minimum speed of 2,000 revolutions per minute.

Finishing. First use a Soft Brown Mop, Quality G, with Rouge Compo, Quality B.H, then for a final glossy finish use Swansdown Mops with fine Rouge Powder, Quality A.

This Rouge Powder is used dry, with the exception of a slight addition of Albo Grease to make it adhere.

Great care should be taken to keep the Finishing Material free from grit and dirt. The best glossy finish is obtained by " racing " the Tube lightly up and down the Mop, working on top of the Mop.

TUBE POLISHING MACHINES.

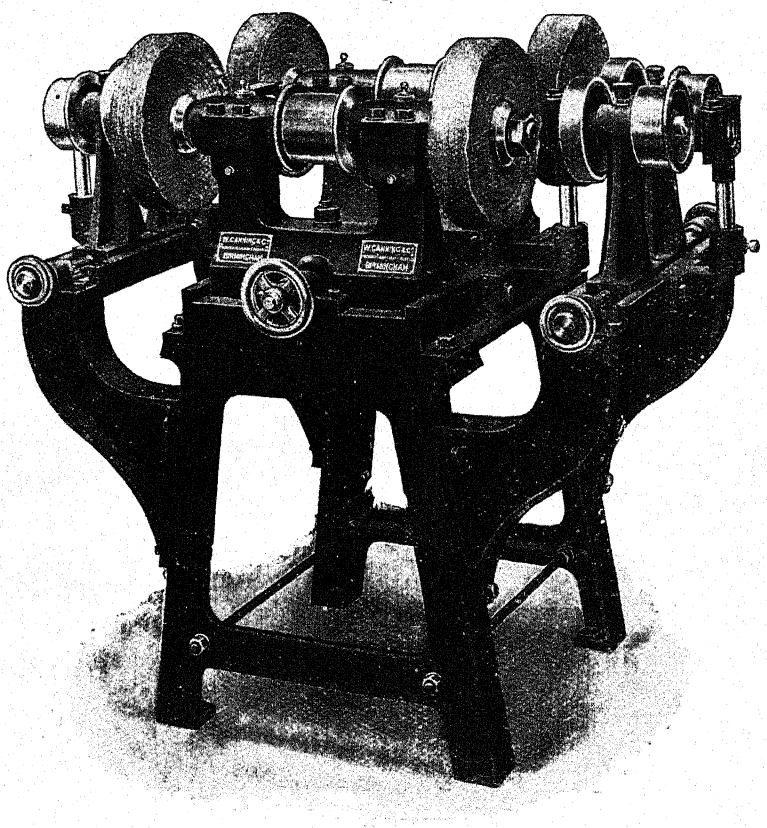
Round Tubes. Round Brass and Copper Tubes and Solid Rods are polished in a machine similar in construction to that illustrated on opposite page.

F Quality Mops (*Catalogue, No.* 429), with Lustre Polish, are put on the cutting end, and our B Quality Mops on the other end, and Rouge Composition, Quality B, is used on the B Mop.

We also manufacture a machine which works automatically. In this machine the Tubes or Rods are automatically guided through the machine by wheels covered with rubber.

Square Tubes. Square Tubes up to 2 ins. square are polished in the special machine illustrated on p. 190.

The Tubes are pushed through the Guides, in which are fitted cubes of the same size as the Tubes to be polished. The Polishing Mops should



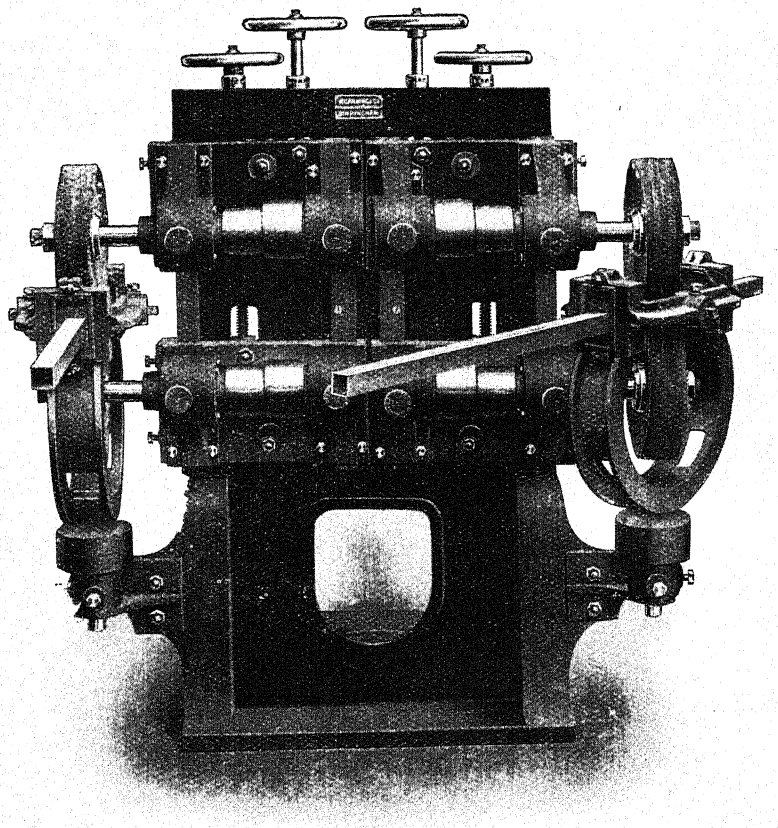
MACHINE FOR POLISHING ROUND TUBES AND RODS.

be fed liberally with Lustre Polish, and the top and bottom Mop so adjusted as to give equal pressure on the Tube. The Tube is first "crossed" on the machine for about three-quarters of its length, the Guide being marked "A," through which the Tube is passed for "cross" polishing. By this means two sides of the Tube are polished at once. It is then turned and the other two sides polished.

The Tube is then passed through the other pair of Guides, which are marked "B," to be straight polished, in two operations, as in "cross" polishing. Polishing Mops, Quality F, size 12 × 2½ ins., with Lustre Polish

are used for Grease Mopping, and G Quality Mops with Rouge Compo, Quality B.H, for finishing.

Final Finishing. The Tubes are finally finished with Swansdown Mops and Rouge Powder, Quality B, on an ordinary Polishing Lathe.



SQUARE TUBE POLISHING MACHINE.

ENDLESS TAPE, OR BAND, POLISHING.

EMERY Tapes and Bands are specially suitable for polishing such articles as Hay Forks, Potato Forks, Brass Cocks, Cycle Parts, Chandeliers, Pot Hooks, Harness Hames, Edges of Spanners, Shovel and Spade Langets, Bright Sockets and Round Engineers' Tools, such as Ratchet Braces, Stocks, and all articles with prongs or curved surfaces where the ordinary method of polishing with Bobs is unsuitable, the flexibility of the band or tape being such as to follow the radius of articles thus polished to avoid making flats or hollows.

Endless Leather Bands, No. 521, **Cotton Emery Bands, No.** 674, are most suitable for all kinds of Forks, Hames, Spanners, Tubes, Spades, Sockets, Stocks, and Ratchet Braces, fixed on Machine, No. 382. The

width of band should be about 3 inches. Spades, Straps and Sockets are polished in one operation with No. 36 Emery.

Emery Tape and Band Machines. These are illustrated and fully described in Section 4. For polishing all kinds of Forks, Hames, Spanners, Tubes, Spades, Straps and Sockets, Stocks and Ratchet Braces, Machine No. 382 is suitable.

Spades, Straps and Sockets are polished in one operation with No. 36 Emery. A stout hook is placed about 1 inch below the surface of the Band and 2 inches away nearest the Operator.

The handle of Spade is put under the hook, and the strap or socket is revolved on Band by Operator until finished.

This method can be employed on all straight round articles.

All kinds of Potato, Garden and Hay Forks, Stocks and Ratchet Braces are done in two operations. They are first roughed on Bands dressed with No. 60 Emery, then with a Band made with Buff and dressed with No. 80 Emery. When the dressing is worn down fine, the Band is used for colouring or final finishing by applying colouring paste and lump charcoal as described on p. 210.

Cycle Parts, Brassfoundry, Electroliers, Gasfittings and Carriage Furniture are best polished on Vertical Banding Machine No. 147, with Emery Tape Bands. These Bands are more suitable for this class of work ; being thin and pliable, they lend themselves to light Brasswork better than Leather Bands. All Brass articles usually receive only one operation with these Bands, dressed with No. 120 Emery, being afterwards finished with Mops as described elsewhere.

Machines Nos. 391 and 392 are used for small articles in either Iron, Brass or Steel in the same manner as described above.

Banding Machines are also used to clean, scour and polish all kinds of wood handles, the same Bands being used, but dressed with ground glass or garnet.

Dressing with Emery. To cover or dress Bands with Emery a portion of the Band is glued, then pulled slowly through the Emery and pounded with a sledge hammer or wooden mallet. By gluing the Band in portions and using the Emery warmed, the best results are obtained.

Removing Old Emery from Bands. For Leather Bands use a flat sharp chisel-shaped tool about 2 inches wide, and slice the Emery off down to the Leather, using the tool over the pulley when the machine is standing.

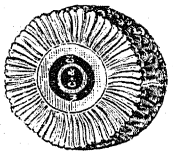
To clear the Emery from Cotton Bands soak in warm water, when the Emery may be easily removed. Dry the Bands *gradually* before dressing again with new Emery.

POLISHING AND FINISHING SILVER ARTICLES.

Articles of Silver are polished in a similar way to Brass-work, with the exception that Soft Leather Bobs are used for sanding and softer Mops used for finishing.

After the articles have been sanded, as described in Brass Polishing, they are polished on a Brown Mop, Quality B, with Crocus Composition ; then they are cleaned and receive a very light coat of Silver in the

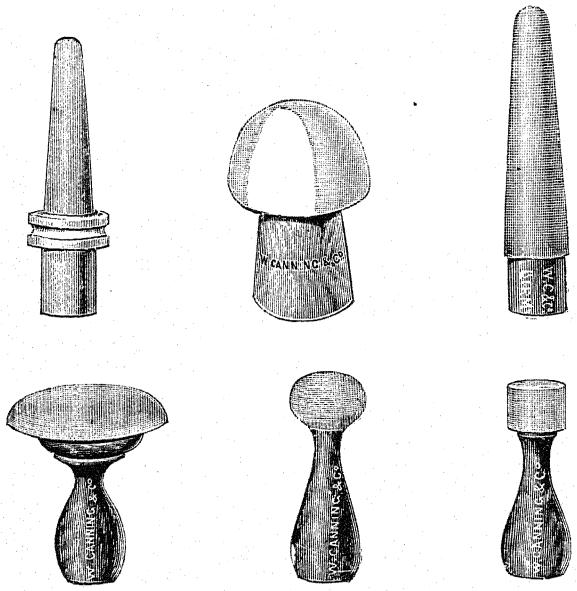
Silver Vat, then swilled, dried out in sawdust, and finished on a Swansdown Mop or Woollen Brush with a little A Quality Rouge, made into a paste with water or Methylated Spirits, then washed in soap and water, dried out in sawdust, and polished again on a Swansdown Mop or Woollen Brush with dry Rouge. The article should then have a beautiful burnished appearance.



Woollen Brushes for Cups, etc.

Articles which have been Electro-plated can be finished in a similar way, but the sanding is dispensed with.

Solid Silver Work, after leaving the making-up shop, is either sanded with Bullneck Covered Leather Bobs, under 6 ins. diameter, and Trent Sand (the leather on these bobs must be of a soft good tannage); the leather bobs used are of solid leather. The sanding is also done with soft

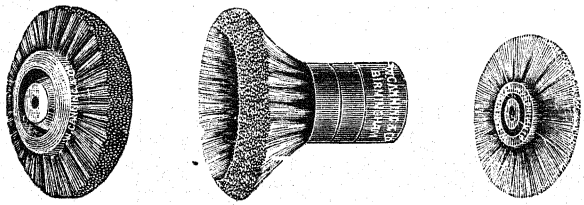


Small Felt Covered Bobs for Sanding.

or medium Felt Bobs—usually medium—and again Basil Mops and sand are used. Where pattern work cannot be sanded with bobs, circular bristle and fibre brushes and sand are used. The work is then mopped on a brown mop (Quality B) and Crocus Composition, and then finished on a soft brown mop (Quality G), or a Swansdown Mop, using either Rouge Composition (Quality A.A.) or Rouge Powder (Quality A. or B.) is mixed with water, oil, or methylated spirits.

Silver articles such as Match Boxes, Cigar and Cigarette Cases, Toilet Ware, Thimbles, Brooches, Watch Cases, etc., are polished, as previously described; but Leather and Felt Bobs of various patterns and shapes have

to be employed according to the shape of the different articles. We illustrate here some of the various Bobs, etc., used for this purpose.



CIRCULAR BRUSHES.

Circular Brushes made of Bristles or Fibre, and revolving on a Lathe, are used for many purposes on these small articles. A hard Fibre Brush, with some Crocus mixed into a paste, is used for polishing where it is indented and impossible to get a Bob or Mop; soft white Bristle Brushes are used in connection with Rouge Powder mixed with water or Methylated Spirits where it is impossible to get a Bob or Mop (see p. 206).

SIDE BOBS FOR POLISHING DEAD FLAT SURFACES.

Silver Fire Stripping Solution.

In many establishments where large quantities of solid Silver work are being made, a solution known as CANNING'S "PYRENE" ELECTRO-STRIPPING SOLUTION is used for removing the fire from the article. The operation is carried out as follows:—

An ordinary lead-lined Plating Vat is used, into which is placed the Stripping Solution. The rods are placed on the Vat as described in the previous part of this book. Lead Sheets are hung on the negative rod of the vat, and the article is hung on the positive wire, consequently the article acts as an Anode, and a small amount of Silver is deposited off the article, which removes the fire and leaves a clean surface for polishing, the silver being retained in the solution. When the solution is so charged that it will not take up any more, it is thrown down and the Silver recovered in the usual way. This method of removing the fire is much more satisfactory than Polishing, and saves time, materials, and silver.

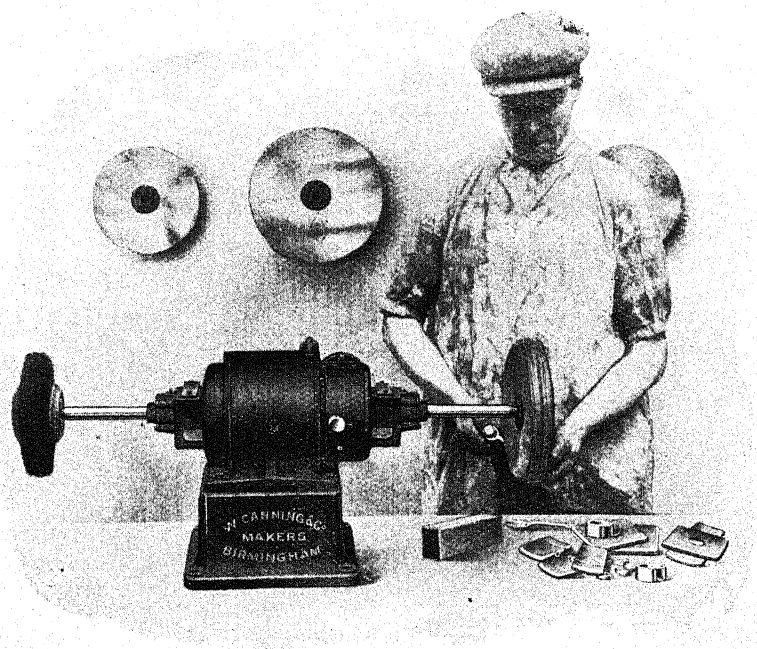
POLISHING AND FINISHING ARTICLES OF JEWELLERY.

THERE are so many different articles, and ways of treating them, that it is difficult to describe them all. They are polished, in many instances, in a similar manner to Silver Work, but with different material.

Circular Brushes made of Bristle are largely employed for Polishing Jewellery.

The article is first brushed with a Circular Brush (see p. 193), with Crocus Powder mixed with Oil. It is then washed out in a Hot Solution of Water and Washing Soda, dried out in sawdust, and finished either on a fine White Bristle Brush, soft or Chamois Leather Mop, or a Woollen Brush, with a little A Rouge Powder mixed with water; Felt Bobs, very soft, are often employed.

The article is then washed again in either the Soda Solution or Soap and Water, dried out in boxwood sawdust, and polished on a Mop or very fine Brush with dry Rouge.



ELECTRIC POLISHING MOTOR.

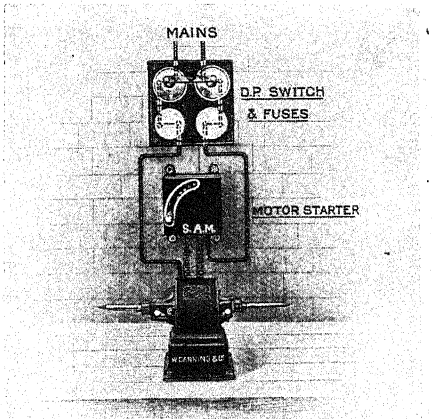
All the articles used for Polishing Jewellery are very small, the Mops, etc., being usually from 1 in. to 6 ins. diameter.

A large quantity of Jewellery which is very delicate and has many stones is usually polished by hand with the same material, but various sticks and polishing threads, etc., are used (see p. 205).

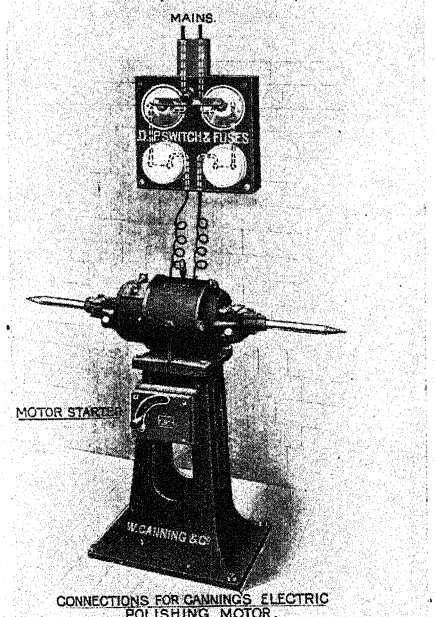
Electricity is used for driving Polishing and Grinding machinery, the Motor being made to revolve at a high speed, the shaft or spindle of the motor being extended so as to admit of the bobs or mops being the desired distance from the casting or frame of the motor.

The machine illustrated is a self-contained Electric Polishing Motor. The Motor is for continuous current, and totally enclosed. These

machines will carry Mops and Bobs up to 10 ins. diameter, and are running in Railway Carriage Works, Motor Car Works, Tin Plate



CONNECTIONS FOR CANNING'S ELECTRIC POLISHING MOTOR.
(ARRANGED FOR BENCH)

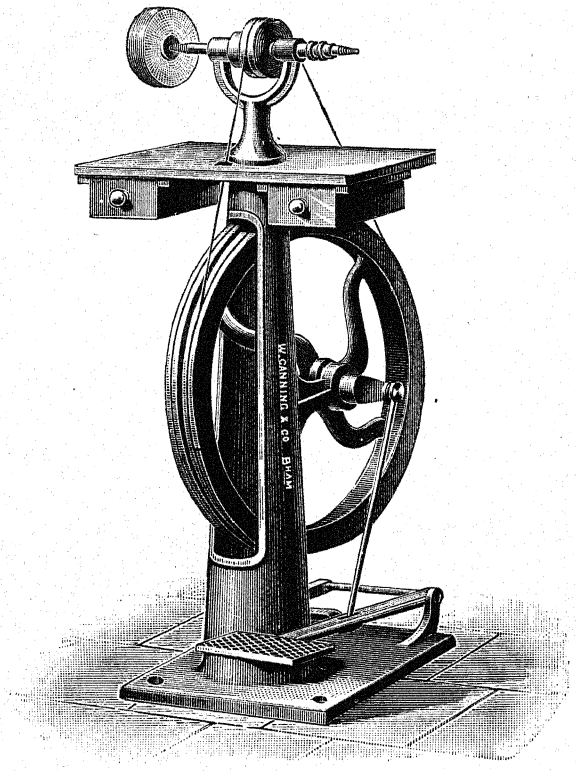


CONNECTIONS FOR CANNING'S ELECTRIC POLISHING MOTOR.

Works, Brassfounders' and Cycle Works, Telephone Works, Manufacturing Jewellers, etc.

Smaller machines down to $\frac{1}{8}$-horse power are especially suitable for jewellers, dentists, and other trades where small articles are required to

be polished. The spindle is suitable for carrying small Mops, Bobs, and Brushes, and plates can be provided on one end for running



TREADLE LATHE.

Emery wheels, circular saws, etc. In the base of the motor is the necessary starter and Resistance fitted with an automatic no-volt release attachment.

POLISHING BY SHAKING.

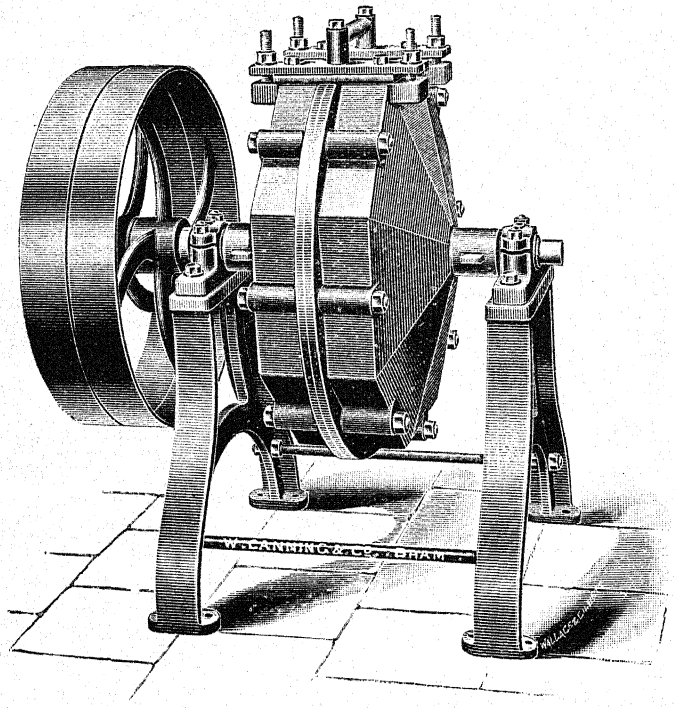
POLISHING by shaking is an economical method of polishing rough castings, etc., and is accomplished by placing the articles in a Shaking Barrel with a suitable polishing medium and revolved for a certain length of time, dependent on the finish required. The continual friction of one article against another in connection with the various ingredients put into the Barrel, cut, grind, polish, or burnish as required.

The most important points to determine are the size and kind of Barrel for the particular class of articles to be treated, followed by the method of using it, the material to be used, the speed at which the Barrel is to revolve, and the time necessary to produce the desired finish:

Under no circumstances should the Barrel be run so fast as to carry the articles round with it.

No one Barrel will suit all articles, although one particular Barrel may suit totally different articles. Even with the fullest experience it is almost impossible to determine by examination of the articles what material, time, and speed is necessary to produce the best results, although the most suitable type can generally be decided at once.

The articles to be treated can usually be defined as being heavy or light, and if made of iron and steel can be either polished or burnished; but if made of brass, a better result can be obtained by Barrel burnishing than by polishing.



SHAKING BARREL, No. 412.

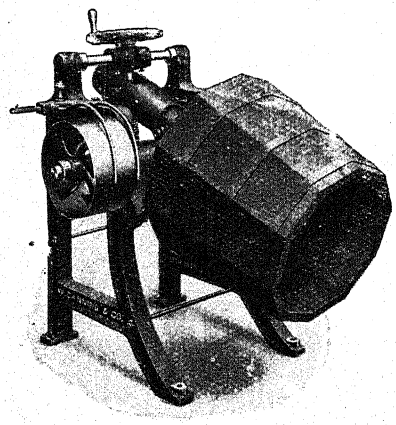
Shaking Barrels are made in various shapes, diameters, and lengths to suit the different classes of articles to be treated, and are run vertically, horizontally, obliquely, and sometimes a combination of nearly all these motions. Generally speaking, Barrels may be divided into two classes: the totally enclosed and open-ended.

It must be remembered that Barrels are not suitable for polishing all classes of articles, as for instance those with sharp corners or those where it is desirable that the edges are to remain sharp; on the other hand, by a slight alteration in the casting pattern articles that are now finished by hand might be expeditiously dealt with by means of a suitable Barrel.

Before leaving the general question of Barrelling, it would be well to point out that it is often necessary to try several methods to find out the most suitable type for a particular class of article, and although Barrels are being used more every day — due to the very low cost of production—there are still certain articles which require special treatment and consideration.

Light articles will stand higher speeds than heavy ones, and while it is desirable to use the highest speed possible in order to save time, a surface speed of about 180 ft. per minute should not be exceeded for light articles in an enclosed Barrel, or about 125 ft. per minute for medium articles, and about 80 ft. per minute for heavy articles. For the Open-ended Barrel the class of articles largely decides the speed, but for a general guide from 150 to 200 ft. per minute.

The desired smoothness or polish on articles shaken in a Shaking Barrel can only be obtained at the expense of time, as the articles are spread over a considerable surface and the friction is slight. The Barrel illustrated (*Catalogue, No.* 412) is a typical Barrel for heavy articles. Its peculiar tapering or wedge-like form increases the friction very greatly, and causes the articles to be constantly changing their position by a continuous roll instead of the sliding action which is liable to take place in Barrels of ordinary construction. They are made singly or for a pair to run on one spindle.



Polishing Barrel, No. 934.

The Barrel next illustrated (No. 984) is an Open-ended Barrel for polishing and burnishing. With the tilting device for emptying, it is possible to quickly separate the articles from the Solution without touching them with the hands.

With all wet processes of Barrelling it is necessary to have an efficient method of drying the articles on completion.

When the articles are finished in the Barrelling process, they are well swilled in cold water, then in hot water, and dried out in sawdust. Special Sawdust Drying Barrels (No. 983) as illustrated are used. The articles are placed with sawdust in the gas-heated Barrel and revolved, when the articles are quickly dried, and the barrel tilted by a lever for emptying.

A similar Drying-Out Barrel will be found illustrated on page 87. This is of a more elaborate design and has a larger capacity than the pattern illustrated here.

This Barrel can run at any angle, and when the belt-moving gear strikes the belt on to the loose pulley it automatically cuts off the gas-supply.

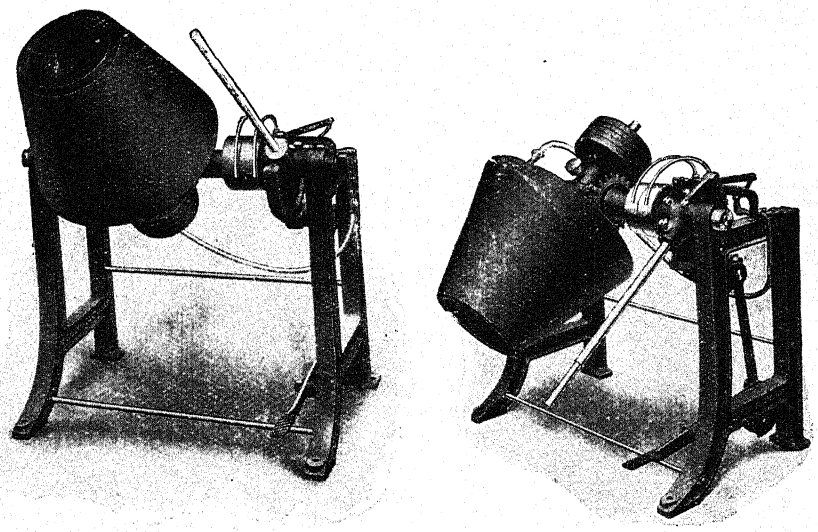
Cleaning of the Wood Finishing Barrel. When starting to use a new

Barrel and also from time to time when in use, put hot water and ¼ lb. of washing soda into Barrel, fix lid, and run for an hour. Follow this with clean water and run one hour again ; it should then be ready to put in the work to be burnished.

The Steel Burnishing Balls. When not in use, have them dried out in sawdust, and keep in dry room ; if they are allowed to get at all rusty they will not burnish the work. Disappointing results frequently occur if the operator is at all careless and does not appreciate that absolute cleanliness is of the first importance in working by this process.

New Steel Balls should be carefully freed from grease before being used, or the Barrel will be spoiled. Clean well in a hot Solution of Caustic Soda and Water.

For shaking sand from Brass Castings a perforated Barrel, No. 414, as illustrated, is used.



SAWDUST DRYING BARRELS, No. 983.

The Barrel is perforated all over, and as it revolves shakes the sand from the castings, the sand falling through the perforations into a box which should be placed underneath the Barrel.

Cycle Spokes are shaken in Hexagon Wooden Barrels, No. 410, usually about 10 ins. in diameter. Each compartment of the Barrel should be about ½ in. longer than the Spoke. The Barrel is revolved at about 90 revolutions per minute ; the faster they are revolved, the better do the spokes roll, and not merely slide round.

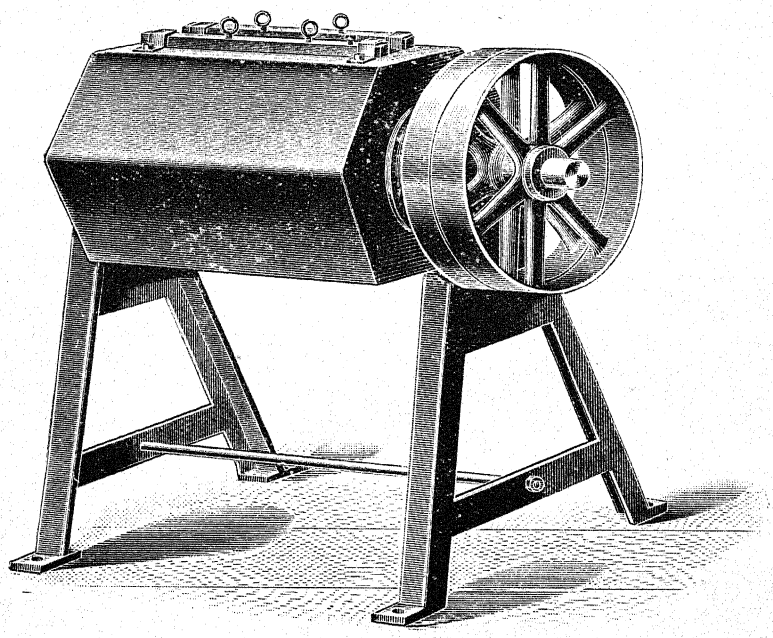
1st Operation. Fill the Barrel, or compartment, to about three-fifths of its capacity, put in about two or three handfuls of fine Mousings, and ½ lb. Flour Emery, and revolve some hours until the outer surface of the Spokes is removed.

2nd Operation. In a separate Barrel, or separate compartment of a Barrel, put the Spokes and two or three handfuls of fine Mousings, with

a sprinkling of Sheffield or Vienna Lime, and revolve, as before described, till the Spokes are sufficiently polished.

Fish Hooks, Pins, and articles of like description, are generally polished with Bran in a Barrel, No. 411, as described in Catalogue.

Special Note. Always remember that articles of different shapes and sizes polish very much better and quicker if mixed together when being shaken, as the smaller articles rub on the inside and different parts of the larger ones. When articles all of one kind are being shaken, castings of different shapes, as illustrated (see p. 201), are used to get into the inner parts, such as holes; and those parts of indentations of the articles which would not come in contact are shaken by themselves.



SHAKING BARREL, No. 414.

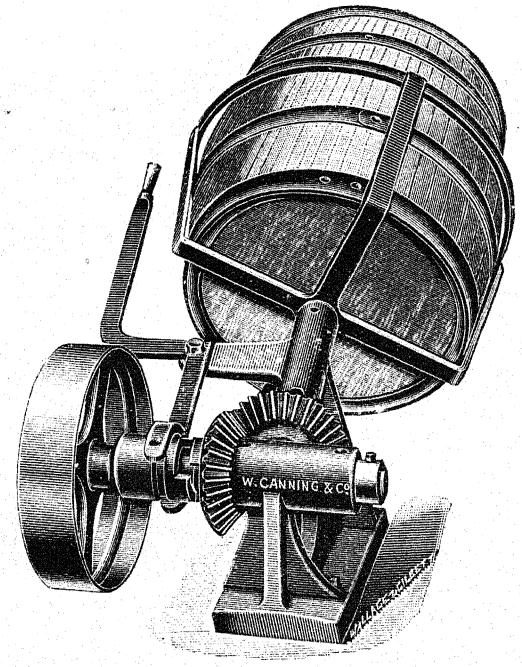
Cast Steel, Iron, or Drop Forged articles may be sand blasted to remove the scale or oxide on the surface of the goods, then either by file or emery wheels remove all fin or edging left from the mould or the dies, to make them ready for the scouring process.

Cast Iron Articles. Into an Iron Barrel of suitable dimension and shape place articles to fill the Barrel two-thirds full, then add about a bucketful of Emery (40 Grit), and about 3 or 4 pints of Shaking Oil.

Fix on the lid, and run the Barrel until the articles have a thoroughly scoured surface. From time to time take off lid, and if found perfectly smooth in all parts, put into Barrel plenty of sawdust, then put on the perforated lid supplied for the purpose, start the Barrel, and when all the dirt and sawdust have been shaken out through the

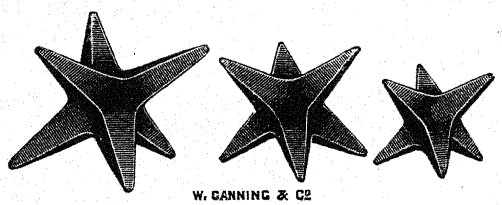
perforated lid, take out the articles and put into a clean Barrel for the finishing process.

Cleaning the Barrel. This must be cleaned as described on p. 198.



POLISHING BARREL, No. 411.

Finishing the Work. Into a clean Iron Barrel free of all grit, put the work and a few handfuls of Mousings free from grease and a few gross of steel cycle balls or scrap according to the nature of the article; these



RUMBLING STARS.

drive the Mousings through the articles and improve the finish; run Barrel until the desired finish is obtained. For work of a cheap class a finish may be obtained by using Beech sawdust alone.

PREPARATION OF ARTICLES AND THE PROCESS OF SCOURING AND POLISHING IN A BARREL.

Hardened Steel Articles. Such as articles which are hardened and tempered and it is desirable to remove the scale to get a better surface. Into an Iron Barrel of suitable shape and dimensions (Harrison's Patent Pattern preferred) place the articles. If they are of such a shape that they will not polish alone, add about a peck of Soft Steel or Iron Scrap Plugs to each bushel of articles, and about 20 lbs. of ground flint or any sharp sand free from pebbles, and a piece of Caustic Potash about the size of a walnut. Then add water just sufficient to cover the contents, and run the Barrel until the articles are cut down, at which time they will have a fine silver-grey colour. Wash the articles thoroughly, and transfer them to another Iron or Wood Barrel for polishing—never use the cutting-down Barrel for polishing—add about 1 pint of Vienna Lime, 4 ozs. of Cocoa Butter, cover with water, and revolve until the desired finish is obtained. Wash thoroughly in cold water, dip in Benzine or Motor Spirit, and dry out in an oblique Barrel with clean sawdust.

The Steel or Scrap Iron used in the cutting Barrel can be used over and over again. Care should be taken when opening the Barrel, as some gas is formed, and the Solution is apt to spray out.

Another method of scouring some articles is to place them in a suitable enclosed Barrel, and add a mixture of Emery (No. 40 Grit) and oil. After scouring, the articles must be well cleaned by placing in another Barrel containing a Solution of 1 lb. of Caustic Soda per gallon of boiling water; it removes all grit and dirt. In another Barrel the work is finished with Vienna Lime as described above, or by placing the work in a Barrel with Leather Mousings and Steel Balls.

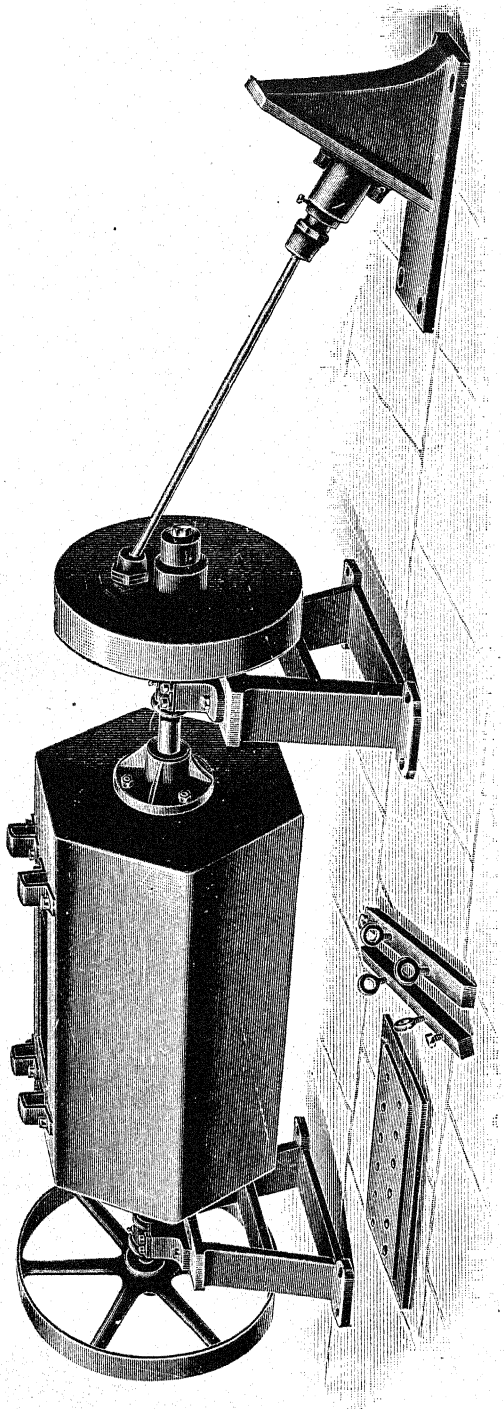
Soft Steel or Wrought Iron Articles. To each bushel of articles add about 10 lbs. of very fine abrasive, such as dry Tripoli, Pumice, or very fine Sand such as moulders use. To this add ½ pint Soft Soap, cover with water, and polish in an Iron Barrel as described under Hardened Steel Articles.

This operation does not take so long as for Hardened Steel, but if the goods belong to the light class and are made from bright cold-rolled steel, a much simpler way is to dispense with the cutting down, and use, to polish, a bushel of articles, about ½ pint of Soap Bark, and ¼ pint Cream of Tartar. Fill the Barrel nearly full of water, and revolve until they have a clear surface.

If the shape of the articles is such that they will not polish properly by themselves, a quantity of steel balls, iron rumbling stars, or scrap should be added to break up or separate the articles and generally assist in the polishing process.

Wash in clean cold water, and dry in sawdust.

If the articles are to be nickel-plated, after plating revolve for about 2 hours in Borax Water; but if the work is for Brass Plating treat after



HARRISON'S PATENT RAPID BURNISHING AND SCOURING BARREL, No. 819.

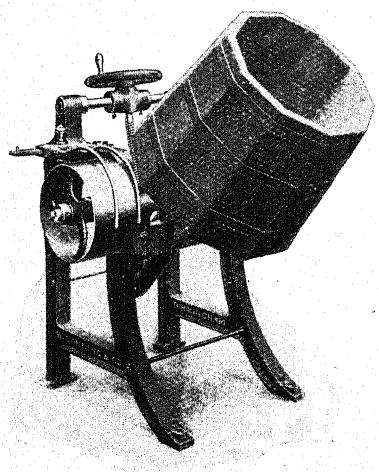
plating in the same manner as described later under " Burnishing Brass," but for a shorter time.

Another method of polishing Iron Work is to place the articles in a suitable Iron Barrel together with a quantity of Leather Mousings, cover the whole with a dusting of Sheffield or Vienna Lime, and add, if necessary, Steel Balls, Rumbling Stars, or Scrap, according to the nature of the articles, to break up or separate the latter. The time necessary for this process depends on the nature of article and finish required. This process is somewhat cleaner than the previous one, but is not suitable in all cases.

Cast Brass Articles.

First Barrel Process. Having decided on the size of the Barrel required and the speed (our Wrought Iron Harrison. Patent Pattern, illustrated on page 203, is most suitable), place the articles in the Barrel, adding 10 lbs. of Coke Dust or Moulder's Sand to every bushel of articles.

Fill the Barrel two-thirds full, and nearly fill up with water. In some cases the addition of ½ lb. of the very best Soft Soap can be used to advantage, but in most cases this can be dispensed with. The time necessary for the scouring process depends upon the nature of the articles, which, of course, control the speed. If necessary Steel Balls or Scrap should be added as already described. The articles are afterwards carefully swilled clean of all particles of grit, and placed in a Wood Harrison Shaking Barrel of suitable size with Steel Balls, the quantity being about one-quarter of the volume of the articles. To this add a packet of Dry Soap or a little Flake Soap, and nearly fill up the Barrel with water. The time necessary for the finishing process varies considerably, depending on the nature of the articles and the finish required.



TUMBLING BARREL, No. 984

In some cases bright dipping in Aqua Fortis for Cast Brass work after the scouring process is beneficial, and in the case of Cast Flat Articles, such as a plate with raised parts, it is necessary, as the background is little affected by the shaking.

After the articles are removed from this Barrel they should be thoroughly washed in cold water, then in hot water, and dried out in our Hot Sawdust Barrel No. 983 (illustrated on p. 199) or in a Sawdust Pan, using clean hot Boxwood Sawdust.

Stamped Brass Articles. These must be divided into two sections, light and heavy. The heavy articles are treated in exactly the same manner

as Brass Castings, except that in some cases the stampings are so poor that the scouring or cutting down process can be dispensed with, the articles being dipped bright in Aqua Fortis before being put into the Finishing Barrel.

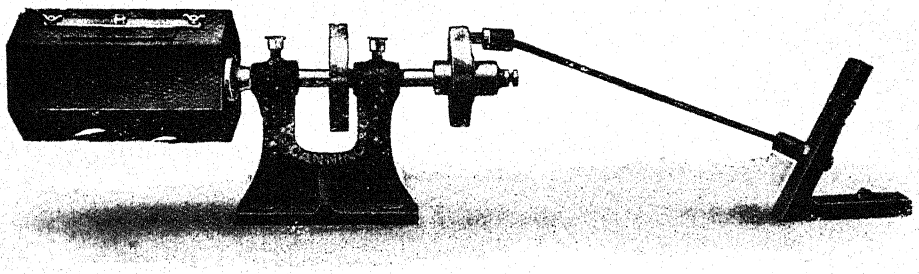
Light Brass Stampings have each to be considered on their merits, some articles being done excellently in a Harrison Barrel running at a proper speed, while for other articles this type of Barrel is too vigorous, so for this class we recommend bright dipping in Aqua Fortis before finishing, dispensing with the scouring process, care being taken to well swill the articles before putting them into the Barrel. The most suitable Barrel for this class of article is either No. 984 Barrel (illustrated on opposite page) or Harrison's type (p. 203).

The articles, together with Steel Balls, Dry Soap, or Canning's Flake Soap and Water, as before described, are placed in the Barrel, and revolved until the desired finish is obtained. Then the contents may be emptied by tilting the Barrel by means of a screw at the back. The articles are then swilled in clean cold water, and dried in clean hot Boxwood Sawdust in the same manner as described under Cast Brass work, our Sawdust Barrel No. 983 (illustrated on p. 199) being especially suitable for this class of work, giving it a final polish.

SCOURING AND BURNISHING GOLD AND SILVER CHAINS, ETC., IN HARRISON'S PATENT SHAKING BARREL.

Scouring Gold.

Gold Stampings (parts of Jewellery) are first scoured in a Harrison Patent Iron Barrel, about 6 ins. diameter across the flats and 12 ins. long, inside measurements. Put of fine Coke Dust about 3 pints, then the



PATENT BURNISHING BARREL.

articles, and cover with clean water to a depth of about 2 to 3 ins., and revolve until all traces of oxide produced in the manufacturing processes have been removed, and in some cases until sharp edges have been rounded.

The Coke Dust can be used over and over again, as the finer it gets the

better it will do its work. This dust and the water should not be thrown away, as it is valuable.

Gold Chains, Brooches, Bracelets, etc., are first stripped in Canning's "Stripene" Electro Stripping Solution (see below) to remove the flux and oxide, and are then ready for the burnishing and finishing process without the Barrel Scouring.

Burnishing Gold.

Gold Stampings, after being scoured as described, or Gold Chains, etc., after being stripped, are thoroughly washed in plenty of clean water. A good plan is to place them in a sieve and run clean water over them and shake them to clean every part, then put through a swill consisting of Cream of Tartar 4 ozs., water 1 gallon, to remove any grease.

They are now ready to put into the Harrison Wood Burnishing Barrel; the Barrel must always be chemically clean. To the articles add about 80 gross of *the very best Steel Balls, not seconds,* but the highest grade and finish, clean and free from rust, of suitable size, care being taken to see that they are perfectly free from grease and dirt before being put into the Barrel. Add to the articles and balls about half a packet of Dry Soap, and cover the whole with *quite clean* water until the Barrel is nearly full, and run until the desired finish is obtained. Wash the articles in clean warm water, and dry in clean Hot Boxwood Sawdust. The desired results can only be obtained when the strictest attention is given to the details of the process. Use fresh soap powder and fresh clean water with each lot of work. When the Steel Balls are not in use they must be carefully and thoroughly dried, and kept in a dry place. Rusty balls, like rusty burnishing tools, will scratch and not burnish. Articles burnished in this way can afterwards be gilt in the usual way.

Scouring Silver.

Silver Stampings are scoured in the same manner as described for scouring Gold.

Silver Chains, instead of being scoured, are treated in Canning's "Pyrene" Stripping Solution to remove the fire (see p. 193), and are then ready for the Burnishing Process.

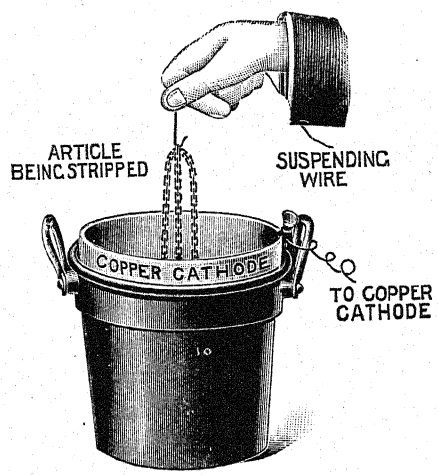
Burnishing Silver.

Silver Chains are burnished in the same manner as described under Burnishing Gold Chains, etc.

STRIPENE ELECTRO GOLD STRIPPING SOLUTION.

We make Solution for stripping from gold articles the flux which is caused by the numerous operations of hard soldering. The flux and oxideformed is very difficult to remove, and is seldom perfectly done by picking or polishing. The Gold Stripping Solution is placed in an earthenware or

enamelled iron vessel; a copper cathode is placed round the articles, and the article to be stripped is made the anode. A current is used at 5 or 6 Volts, and the article is allowed to remain in the Solution till it is smooth



and bright, when it is taken out, swilled and polished on a mop or brush in the usual way, or put in our Patent Burnishing Barrel (see p. 203) with steel balls and burnished.

STRIPPING GOLD, SILVER, BRASS, AND COPPER FROM BASE METALS.

For this purpose an ideal Solution is "**Canning's Barene Stripping**" **Solution** for stripping gold from Base Metals, Silver from Base Metals, such as Dish-Covers, Tea and Coffee Pots, Spoons and Forks, and articles of general Tableware; also for stripping Brass from Iron articles such as Motor-car Fittings, and Copper, Tin, and Zinc from Iron.

Vat. The Solution is placed in a plain Iron, Enamelled Iron, or Stoneware Vat. Lead-lined Vats must not be used.

Anodes. The article to be stripped acts as the Anode, and is suspended from the centre rod on the Vat, steel sheets being used as the Cathodes on the two outside Rods.

Suspend the Anodes and Cathodes in the Solution with Iron Hooks or Wire.

Temperature. Work the Solution at a Temperature of 60° Fahr.

Current. An ordinary Plating Current is used, generally about 6 Volts, but if a higher Voltage is used the process is quicker.

Note. It is of the utmost importance that the actual Stripping Process is closely watched. Immediately the article is stripped it must be removed from the Solution, otherwise the Solution will attack and deface the base metal, particularly Brass, Copper, and German Silver, and more particularly Britannia Metal.

BUFFING OR OVERHAND POLISHING.

THIS method of polishing is applicable chiefly to large articles, such as grates, stoves, fenders, firebars, sadirons, and to engineers' work, such as hand wheels, handles, connecting rods, and to all parts of machines that are not required to be absolutely true. Also to all kinds of edge tools, such as butchers' cleavers, choppers, hooks, scythes, axes, shovels, hoes, hatchets, picks, spades, forks, agricultural implements, steel toy work, hammers, pincers, pliers, and engineers' small tools.

The size of the Machine required depends upon the size of the Bobs to be used for the various articles enumerated under this heading.

In the above trades, in almost every case the articles are first ground on a wet grindstone or emery wheel before the polishing process is commenced.

We recommend Overhand Buffing Machines, similar to No. 409, illustrated and described in Section 4 of Catalogue.

The Bobs or Buffing Wheels are made of specially selected well-seasoned wood, particular attention being paid in the construction to prevent warping or shrinking. They can be run with safety at the speeds named.

For large heavy Bobs iron centres should always be used to carry the wheel on the spindle of the machine to ensure true running (see *Catalogue, No.* 661.

Particular attention has been paid to the turned iron centres, No. 661, whereby the wheel is carried on the spindle, consequently remaining true.

The faces of the Bobs are covered with different kinds of Leather or Felt, according to the nature of the article required to be polished. To cover the Bob with Leather or Felt, the Bob is first turned perfectly true on the face, afterwards using a sharp pointed tool to score or nick the face of the Bob which results in the glue having a firmer hold. The Leather or Felt is then cut into strips about half an inch wider than the Bob to allow for turnings and to give clearance by leaving the covering slightly wider than the wooden centre. The glue used must be of good quality—our 494E or 494D qualities recommended—and should be used very hot and of about the consistency of milk, but must not be boiled. The stoutest and hardest Leather is put to soak for a few seconds in lukewarm water and then well beaten on a hard substance to soften the Leather and remove the moisture. Another method is to nick the Leather at intervals with a sharp knife to facilitate bending. The hair side or smooth side of the Leather should be placed next to the wood and the outside grey coating or tanning scraped off with a knife.

With the material ready at hand the wooden centre is fixed in a vice and the Leather fixed as per instructions given on p. 174. The Bob will take four or five days to properly dry. The drying should not be hurried by heating or the Bob will be spoilt.

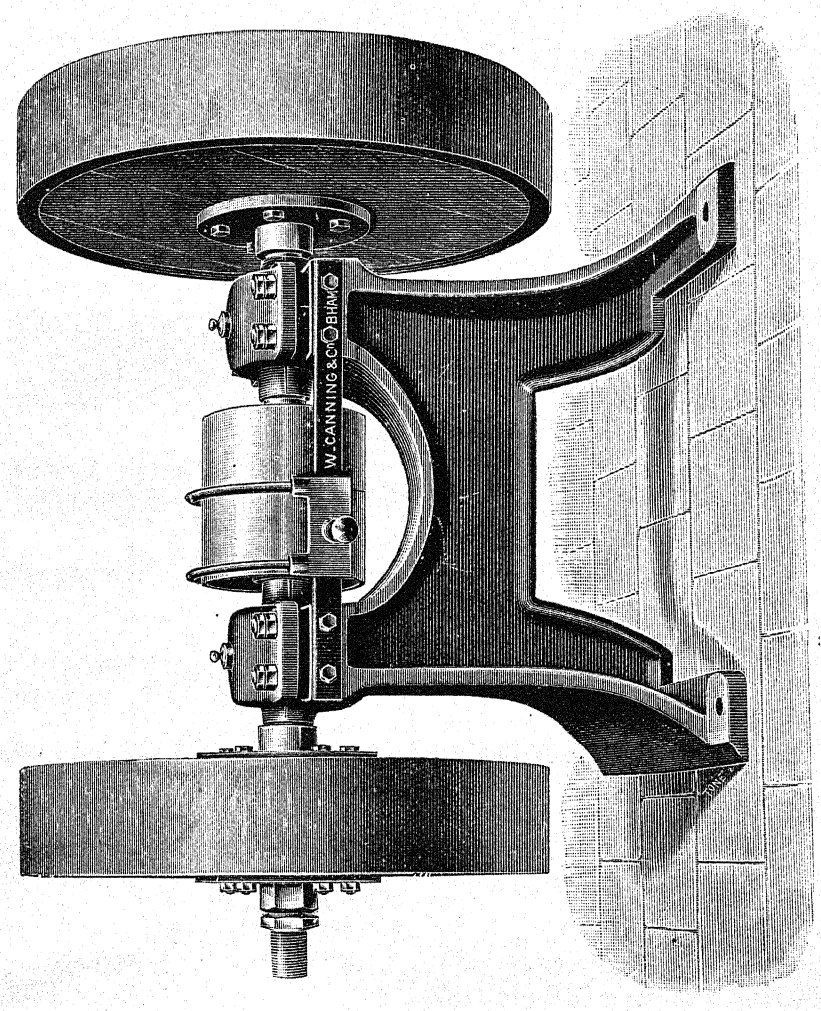
We advise manufacturers who have not sufficient work to employ an experienced polisher, to send their Bobs to us for re-covering, as the process requires skill and experience to accomplish satisfactorily.

To remove old Emery see the instructions given on p. 178.

There are four finishes in this branch of polishing which will practically cover the whole of the trades referred to above, viz. :—

1. Rough Glazing.
2. Roughing and Colouring.
3. Fine Glazing.
4. Oil or Grease Bobbing.

The choice of Leather or Felt for covering is important both as regards finish and economy. Hard Leather for cutting and soft for finishing.



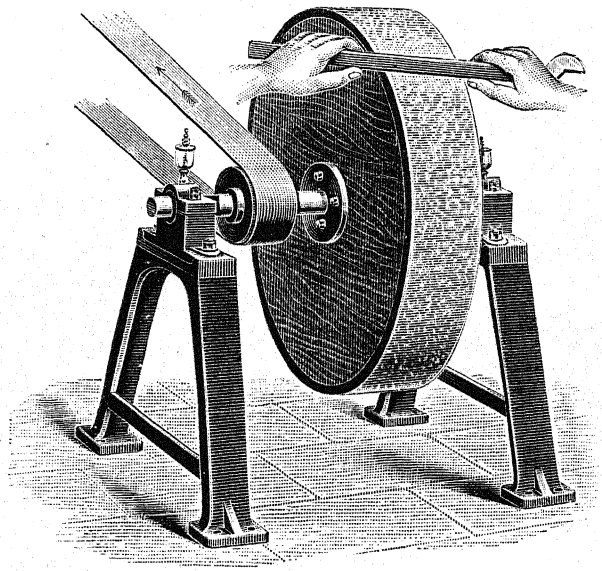
OVERHAND BUFFING, OR POLISHING, MACHINE.

There are three Leathers, each of which contains the properties or textures to enable them to be used in all processes for certain kinds of

work, viz. :—Walrus or Seahorse Hide, Spire Butt and Buff, also superfine Felt.

Rough Glazing. This is done in one operation and is chiefly used on common edge tools, such as common spades, planters' hoes, hatchets, picks and agricultural implements, and for common iron castings. The Bobs should be covered with Walrus or Rolled Leather, such as Bull Neck, Red Buffalo, English Butt, or Spire Butt, and dressed with 40 Emery.

Roughing and Colouring. This is done in two operations, and is generally used on medium quality edge tools, such as bright spades, bright hoes, hatchets, axes, butchers' cleavers and choppers, hooks, scythes, etc. The same Bobs and Emery are used as for Rough Glazing for the first



OVERHAND BUFFING, OR POLISHING, MACHINE.

operation, but for colouring or glossing, the Bob should be covered with Walrus or Plain Bull Neck, Brown Buffalo, Spire Butt, Felt or Buff. The Bob should be dressed with 60 Emery worn down fine, and a small quantity of colouring paste applied with a little lump wood charcoal. Then hold a smooth stone with flat side against the face of the Bob as it revolves, and repeat the operation.

Steel toy work, sledge hammers, pincers, pliers, fire irons and engineers' small tools, etc., are generally done in two processes—these small round and square articles cut off the emery much quicker than the large flat surfaces of spades, etc., and in these cases it is better to use 60 hole Emery to rough with, and 80 hole to colour with, using Spire Butt for the Roughing Bob and Buff Leather glued on to the top of Bull Neck for the Colouring Bob.

Fine Glazing. This process is accomplished in three operations. Bobs covered with Leather, as in the two former operations, are used. Dress for roughing with 60 hole Emery, then polish with Bob dressed with 90 Emery. The articles are then coloured on a Bob covered with superfine Felt, Walrus, Buffalo, or Buff Leather and dressed with 100 Emery. Wear the Emery down fine and apply colouring paste, charcoal and stone, as described previously.

Oil or Grease Bobbing. This process is used on cast steel edge tools. golf cleeks, grates, stoves, etc., which are to be nickel plated afterwards, First polish on Bob covered with Walrus or Bull Neck and dressed with 60 Emery ; then on a Bob covered with Walrus or Bull Neck and dressed with 120 Emery. A Bob covered with Walrus Leather is then used dressed with washed Flour Emery. Wear down fine, mix some Flour Emery with oil in a small vessel and apply a little to the article. Use good pressure when polishing, which will remove all former marks or scratches. The work is then coloured with a Bob covered with Buff Leather glued on to Bull Neck Leather or a Bob covered with superfine Felt.

The Bobs should be dressed with Flour Emery as before ; wear down fine, then oil or grease Bob as in third operation, until a smooth surface is obtained. Hold on the face of the Bob cotton waste or rag whilst revolving, then apply a very little colouring paste and Lump Charcoal, smooth the surface of the Bob with a stone, as previously described, and apply the work again.

These Bobs should be used for no other purpose than oil bobbing and colouring. Keep them free from grit or the work will be scratched. A very much higher class finish can be obtained in the following way : After grease bobbing such articles as golf cleeks, handles for machines, or engineers' fine tools, etc., they can be polished on a Circular Brush, No. 596 or 621, with Canning's Brushing Emery Compo, and afterwards polished on an F quality Mop with Crocus Compo or Lustre Polish. Reverse the grain of each process where possible to ensure the marks of previous processes being removed.

For these high class finishes an ordinary Polishing Lathe is used, No. 360 V being a suitable pattern.

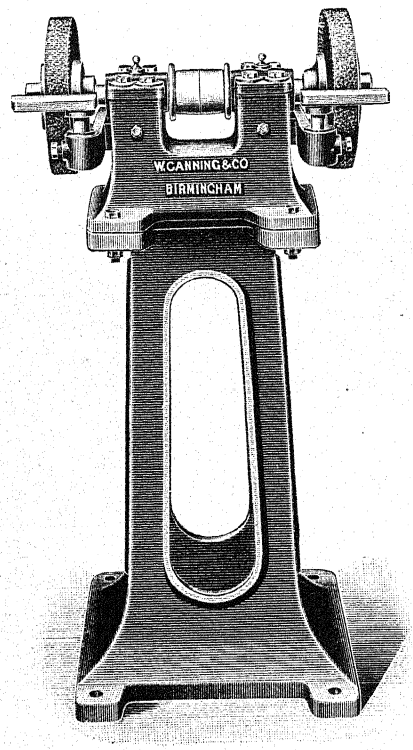
EMERY WHEELS AND EMERY WHEEL MACHINES.

THE advantageous use of Emery Wheels for grinding purposes is generally known, and to-day it may be said that few shops are complete without them. In this work, however, it must be pointed out that they are of no service for *polishing* purposes. As tool grinders they are most useful ; and for rapidly removing or grinding away such parts of the "gets" or projections left from the moulding, or "fraze" from the forgings, and taking off the skin or outer surface from castings or forgings, they are invaluable ; and machines suitable for carrying Emery Wheels are now made for general and special purposes, and

constructed on such principles as to render them practically safe in running.

One point in regard to Emery Wheels cannot be too strongly recommended, and it is that when an Emery Wheel is ordered it should be st ted for what special purpose it is required, for, although a Wheel is made for general purposes, there is greater economy in using a special Wheel for special purposes. A Wheel is made specially for tool grinding or sharpening, and should one be required for dressing brass castings, a Wheel of a different grade is supplied. The same applies to wrought and cast iron.

An Emery Wheel should always be run between plates or flanges, not less than half the diameter of the Wheel, and between the Emery Wheel and the Plate a ring of India-rubber should be inserted. Never trust to frictional or key-way holding on Spindle, and in no case should the Wheel fit tightly or be wedged on the Spindle.



Emery Wheel Machine.

It may be taken as a general rule that an Emery Wheel runs effectively and safely at a surface speed of 4,000 ft. per minute.

For re-turning or truing up a Wheel we supply a special tool (*Catalogue, No.* 407). These tools will be found very useful and effective.

To enlarge a hole in an Emery Wheel take an old half-round file of suitable size, made red-hot, and use as an ordinary file.

To run Emery Wheels to the best advantage, it is essential that the machines carrying them are of good and substantial construction. Our machines are designed with this view; he various types will be found to meet the requirements of every class of work.

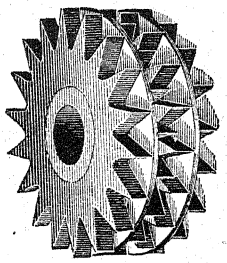
Running. These machines run perfectly rigid, the Spindles are of best mild steel, and proportioned to the weight they have to carry. The Bearings are wide and carefully fitted, so that when driven at a high speed steadiness in working is ensured.

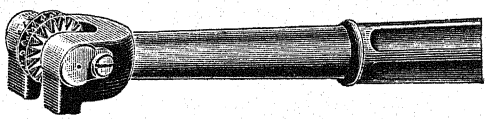
Fixing. Care must be taken to fix Emery Wheel Machines on a good solid foundation, and in proportion to the weight of the machine.

Hand Rest. To prevent the possibility of the article under operation getting wedged between the Rest and the Wheel, the Hand Rest in front of the Wheel must be brought as close as possible to the Wheel and firmly fixed.

Repair. No end play should be allowed on the Spindle. If through long wear the Collars or Bearings become worn, they should be repaired at once.

Spare Wheels. To avoid loss of time and inconvenience we strongly advise our customers to keep spare Wheels in stock for each process.





EMERY WHEEL DRESSER.

When ordering, it is necessary to state the purpose the Wheels are to be used for, whether coarse, medium, or fine, and if to be used wet or dry. Diameter, width on face, and size of hole required in centre should also be given.

Emery Wheels should be frequently examined, and also the Bolts and Set Screws, to see that they are screwed up tightly.

If these directions are attended to, the following will be found the best and most effective Speeds to run the Emery Wheels :—

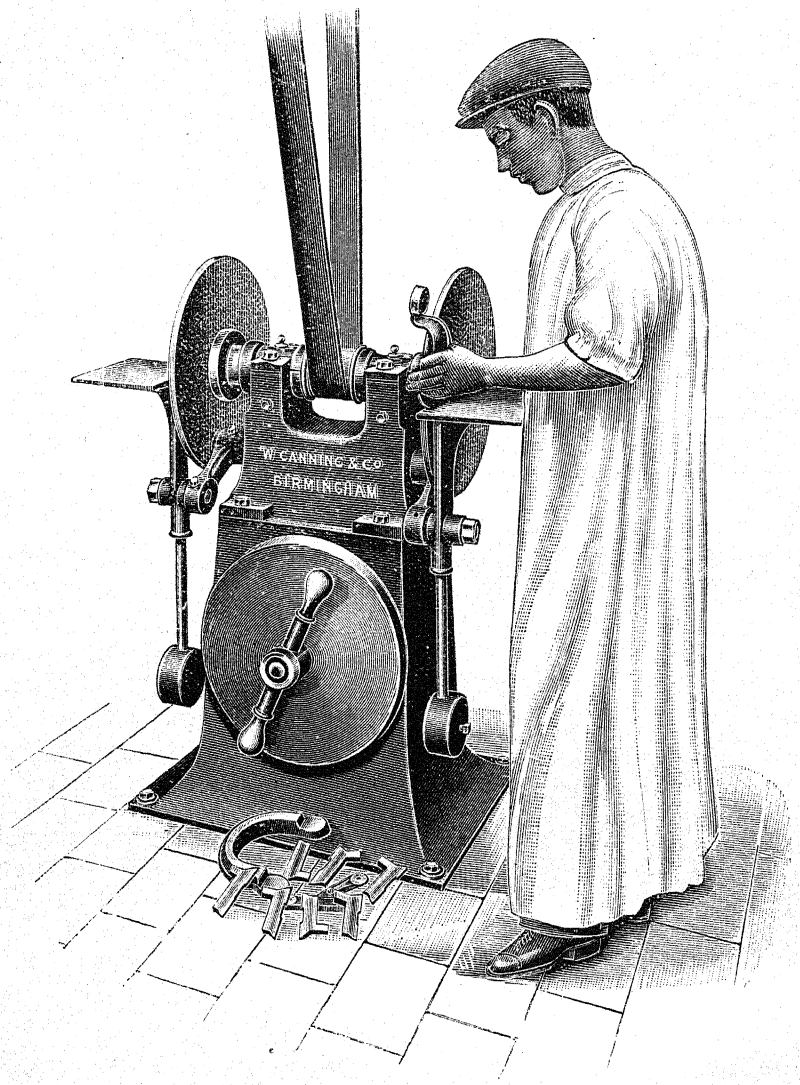
6 ins. diameter and smaller	..	..	2,500	revolutions	per minute.
7 ins. to 9 ins. diameter	..	..	2,000	,,	,, ,,
10 ins. to 12 ins. ,,	..	..	1,600	,,	,, ,,
14 ins. ,,	..	..	1,300	,,	,, ,,
16 ins. ,,	..	..	1,200	,,	,, ,,
18 ins. ,,	..	..	1,000	,,	,, ,,

DISC SURFACE GRINDING MACHINE.

THE advantage of using a machine of this description for grinding Iron and Brass Castings is that an absolutely true flat surface can be obtained. The machine, as illustrated, is constructed with long Dust-proof Bearings, self-oiling ring type. On the ends of the Spindle are attached Steel Discs, on to which are cemented Emery or Corundum Paper Discs. The machine is invaluable for grinding castings, such as Electrical Brush-holders, Flat Brass-foundry, Sash Fittings, Cabinet Handles, Lock Furniture, Name Plates, etc., and any article with a flat surface which requires filing. A rest on either side of the machine is provided for the work to be operated upon, adjustable to any position on the surface of the disc, thus enabling the operator to pass the article across the surface of the disc.

Fixing Paper or Cloth Discs to Metal. The metal disc must be quite clean. Each time a new paper or cloth disc is to be fixed the metal disc should be cleaned in a hot solution of Canning's "Lyco," or a strong solution of Hot Soda Water.

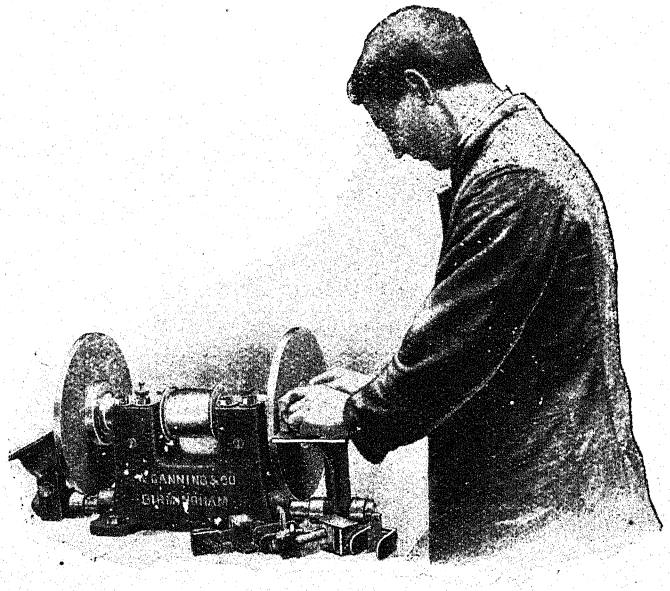
The metal disc should be warmed and preferably the cloth disc also, so that when the cement is applied it will not become chilled. Use the cement sparingly—that is, see that the whole surface has a *thin* layer all over. If the cement is put on too thick, or in lumps, bad results will follow.



DISC SURFACE GRINDING MACHINE

Let the disc stay in the press till the cement is hard and dry. When removing the old paper or cloth disc from the metal disc, soak in warm water for a few minutes, when it can be easily removed.

Notes to be Observed when running Emery Disc Machine. See the machine is fixed on a good solid foundation, so that no vibration takes place.



BENCH DISC GRINDING MACHINE.

See cement is evenly spread over the whole surface of the disc when cementing it, or it may prove lumpy when in use.

Always keep a spare set of discs ready for fixing to the machine when one is worn out.

BURNISHING BRASS, ETC.

THE art of Burnishing is that which imparts to metal goods a very brilliant finish, such finish being more lustrous than can be obtained by any other process.

For Brass Goods. These may be burnished all over, or in relief, according to the effect desired; and the processes are described as Hand Burnishing and Lathe Burnishing.

The tools and materials required are :—

Oval Steel Burnisher.
Ball Burnisher.
Flat or Spade Burnisher.
Round „ „
Bent Oval Burnisher.
Round Nose „
A special Burnishing Buff (*Catalogue, No.* 650).
Burnishing, or Putty Powder (*Catalogue, No.* 652).
A supply of Argol.
Stoneware Oval Pan (*Catalogue, No.* 309), of a size to contain sufficient water to submerge the work operated upon.
A small cup or vessel to contain—
Ox Gall or Vinegar.
Cream of Tartar.
Soda.

Having all materials at hand, the pan should be filled with clean cold water, into which should be scattered Argol (1 to 2 ozs. to the gallon).

Put a small quantity of the green liquid contained in Ox Gall or Vinegar into the cup.

Sprinkle some Putty Powder on Burnishing Buff, and well polish the working surfaces of Burnishers.

Hand Burnishing. The operator should take the article to be Burnished, place it firmly on bench or in a vice, as may be convenient or necessary.

Oval Steel Burnisher.

Dip left hand in the Argol Water, and wet the part which requires Burnishing.

Dip the Burnisher (which should be of suitable shape for part which is to be Burnished) into the Ox Gall or Vinegar (Ox Gall is recommended when obtainable), and apply with pressure to part to be operated upon. Move the Burnisher to and fro until a lustre is obtained.

In applying the pressure, care must be taken that the Burnisher does not drag or scratch the surface of the metal.

Ball Burnisher.

During the operation the fingers of the left hand should be frequently dipped into the Ox Gall or Vinegar, and applied to the work or put on the Burnisher; also give the work an occasional swill in the Argol Water.

If a number of articles are being Burnished, as each is finished it should be put into and allowed to remain in Argol Water until a number are ready for swilling and drying out. Do not let any remain longer in the Argol Water than necessary.

The Argol Water is to prevent oxidation or tarnishing during process of Burnishing.

When the Burnishing is complete, remove articles from Argol Water, pass them quickly through a solution called "Sharp-water" (made up of

Round Nose Burnisher.

Water 18 parts, Aqua Fortis 1 part), swill in clean cold water, pass through hot water, and dry out in boxwood sawdust (*See Catalogue, Nos.* 351, 352).

The effect of the "Sharp-water" dip will be to clean the dead or unburnished part, and to bring up the burnished part into sharp relief.

For flat surfaces, such as Letter Plates, Door Knockers, etc., where the parts to be relieved are on the same level, the Oval Burnisher may be used with both hands—*i.e.*, the handle should be held in right hand and

the point held by left hand, and by passing this over the article, the whole of the raised surfaces are operated upon. By this means greater pressure may be used and the process is more rapid.

For very large surfaces we supply special Burnishers with two handles

Should the Burnisher slip over surface of work without effect, it is due to presence of greasy matter, in which case dip finger in powdered Soda or Cream of Tartar (see list), and apply to the place affected.

Lathe Burnishing is adopted where the article to be operated upon is such as will revolve—*viz.*, Bedstead and Fender Mounts, Door Knobs, Lamps, Containers, and Stands.

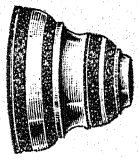
Fix in the Lathe a Chuck or Matrix, made of Brass, Iron, or Spelter, of suitable form to receive the article, which should slip easily on such a Chuck.

Prepare Burnishers, Argol Water, Ox Gall, etc., as for Hand Burnishing.

Place the article on the Chuck, and apply Burnisher. The article will then revolve.

If it is to be Burnished all over, commence in centre or smaller part, and gradually bring Burnisher towards outside or larger diameter of the work. For this purpose we recommend a first operation with Round Nose Burnisher. Afterwards finish with a Flat or Spade-shaped Burnisher. This leaves an even finish.

To put bands or hoops of burnished relief, a slight groove should be made on the work with turning tool to mark the space for Burnishing. This process will clearly define the edges of burnished line or hoop.



If it be a large article, it is advisable to Burnish the centre of the work, and then place a small wood block against it and screw up the back centre of lathe. This will effectually hold work on chuck. The block will revolve with the work.

For Ornamental Stamped or Cast Work, in which the part to be burnished is raised, the same process is followed as in Hand Burnishing, The tool will Burnish the raised parts and pass over the dead, or unrelieved, portions.

Use the Ox Gall or Vinegar frequently, as in Hand Burnishing; but as in lathe work the friction is much greater, it is advisable to hold in the left hand, and against the work, a piece of rag, which should be continually saturated with Argol Water.

Pass the work through "Sharp-water" swill, and dry out, as in Hand Burnishing.

To Relieve Bronzed Work by Burnishing. Bronze as per instructions (see Bronzing). Lightly lacquer to protect the bronzed surface. Scrape Bronze from parts which require Burnishing, and proceed as instructions either for Lathe or Hand work.

Always keep Burnishers bright by frequent rubbings on the buff.

Keep the Burnisher well lubricated with applications of the Ox Gall and water.

Give your work a frequent swill in the Argol Water.

For Gold and Silver Work, see special instructions, p. 137.

DIPPING AND LACQUERING.

BRASS, Copper, and German Silver articles may be finished in various colours, by Dipping and Lacquering, and the following instructions may be useful :—

If the work is not clean, immerse in hot Solution of Lyco to remove all greasy matter, and swill well in clean water.

RESPIRATOR.

The next process to be followed is that of Pickling. The object of Pickling is to remove the oxidation or scale from the metal.

If the metal is rolled and retains its bright clean colour it requires very little attention in the way of Pickling, but if it has been annealed, it should be pickled until all the scale is removed.

The Pickling Solution should be made with Aqua Fortis, 2 parts; Water, 16 parts; or Sulphuric Acid (vitriol), 1 part; and Water, 16 parts. Allow the work to remain in this Solution until all the scale is removed. It works much quicker if used warm. Afterwards swill well in clean water.

For Cast Work pickle to remove sand, etc., from the skin of the metal in pickle, as described above; or for quick action make a pickle, 1 part Aqua Fortis, and 2 parts Boiling Water; keep the Solution nearly boiling when in use.

An exceedingly bright, almost lustrous, finish may be obtained on sheet metal by using what is called a "Black Boil," made as follows :—

Boiling Water	1 gallon.
Sulphuric Acid	½ pint.
Aqua Fortis	¼ pint.

(Care must be taken in adding the Sulphuric Acid to the Water.)

The work should be put into this Solution (which must be kept hot), and remain in it until it appears to be black; it should then be removed, and well swilled in clean water.

After Pickling, the work should be placed in dipping basket or suspended on wires and passed through what is called "Phiz," which is weak or partly spent Aqua Fortis; if same is not at hand, new Aqua Fortis to be used. It may remain for a short time in the "Phiz," and as the Acid is acting upon it a dark red cloud will arise from the vessel. Take work from the "Phiz," and swill in two or three earthenware vessels containing water.

The economy of using two or three lots of water is very great, as the water in which the first swill is made soon becomes strong in Acid, and is a useful pickle.

The process should be repeated until the work appears quite clean and somewhat bright.

The work should then be passed quickly through some live—that is, new—Aqua Fortis, and immediately swilled in clean cold water; pass this through hot water, and dry in sawdust. The work should then be ready for Lacquering.

Dead or dull effects are obtained by using a special Aqua Fortis called "Deadening." The work should be passed through the deadening Aqua instead of "Phiz," as before described. Finish in clear live Aqua as for bright work.

The colour of articles which have been dipped and are not required at once, can be kept free of oxidation by dissolving ½ lb. Argol in 1 gallon of water, for further processes such as Bronzing, Gilding, or Plating.

BRONZING.

It must be clearly understood that any articles which have to be bronzed must be thoroughly cleaned, free from all grease, and the method of cleaning is the same as if the article is to be electro-plated.

In the instructions printed, where the colour is given as colouring Copper, Brass, or Silver, it does not necessarily mean that the article must be made of the particular metal, but the surface which has to be bronzed must be of the metal indicated; for instance, an Iron casting can receive a coat of Copper or Brass in the plating bath, and be then bronzed, or a stamped tin article can be coated in the Plating Vat with Copper or Brass, and again this can be coated with silver, and oxidised or bronzed; also a Brass article can be coated with Copper and bronzed, or Silver and oxidised.

In some cases it may be that an article which is made of Tin-plate requires to be relieved in both Brass and Copper. It will require a deposit of both Metals and be relieved on the Mop according to the taste required.

Many different shades can be obtained with the same chemical mixtures by altering the quantities by taking more of some and less of another, or by making the mixture weaker, also by leaving the article in the Solution a longer or shorter time; again, the colours are often changed when lacquering by shading up the lacquers with aniline dyes, which will dissolve in Methylated Spirits, and the various tints required can only be obtained by the operator using his discretion.

We can only give instructions for the well-known colours which, as we have pointed out, can be altered if required to suit varying tastes, but if the instructions given are carried out good results should be obtained. Care should be taken to see that, if an article has a coat of another metal deposited on it, it has sufficient coating to withstand the bronzing chemicals which are applied to it.

An article which is required to be finished bright must be polished before the bronze is applied, and, on the other hand, an article which requires finishing dull must be so treated before bronzing either by sand blasting or brushing the surface with pumice-stone, or frosting with a

scratch-brush according to the finish required. After the article is bronzed have the same Lacquered as soon as possible.

Florentine Bronze. The article to be Bronzed must be Copper or have a coating of Copper (see note at end of Directions). Clean the article in a Solution of Lyco, and dip bright in Aqua Fortis. If of Brass, the article must then be Coppered. Then take a small portion of the Bronze and mix into a paste to the consistency of cream, with clean water. Take a clean Hog-hair brush and well cover the article all over with the paste, not too thick or too thin, then place on a warm plate or Lacquering Stove, not too hot, till the paste is dried, take the article off the stove and allow to cool. Then scratch-brush the paint off well. If there should be any black spots or impurities working from the metal after this process, take a piece of clean rag, slightly damp, and wipe them off; when dry re-paint the article and put on warm plate as before, and when dry to be scratch-brushed; this time the article to be warm, as it will prevent finger-marks, and should finish a nice even colour. Be sure and use clean water when mixing the paste. The article Bronzed should then be Lacquered.

Note. To make Copper Solution for brass articles: To 1½ lbs. Sulphate of Copper add 1 gallon of Water and dissolve, previously adding 4 ozs. of Sulphuric Acid, which must be added to the cold water very carefully and gradually stirred. Place the article on an iron sieve or iron wire basket by itself, and leave in the solution about five minutes. The work should then come out with a clean Copper covering of sufficient thickness to take the Bronze.

Black Bronze on Brass. The article to be Bronzed must be well cleaned, first by passing through a Solution of Lyco, then dipped bright in Aqua Fortis and well swilled. If the work is burnished or polished, it will require cleaning only in *weak* Solution of Lyco. When the Solution has worked some time, it will require strengthening by adding a little more Bronze Powder and Ammonia.

In using this Black Bronze, constantly move the article deep in the Solution till the desired colour is obtained, dry out in boxwood sawdust, then Lacquer immediately after. This Solution should be well covered over when not in use. Earthenware pans with covers, No. 313, are recommended for this Solution.

This Bronze does not diminish the lustre on burnished or polished work, which appears as if ebonised, after treating as before.

Better results may be obtained by dipping the articles in boiling water immediately before and after they are put through the Bronzing Solution.

Into an enamelled iron or copper vessel (the latter is best) put half the contents of one tin and 1 quart of liquid ammonia ·880, add ½ pint of water. Use the Solution hot.

If a bluer shade is required, add to the Powder 1 oz. of Bicarbonate of Potash.

Steel Bronze on Brass. Place the contents of one tin in an earthenware vessel, then add, gradually, one gallon of Commercial Muriatic Acid, well stirring at the same time, and stir from time to time for six hours.

The article to be Bronzed must be cleaned first by passing through a Solution of Lyco, swilling in water, dipping in Aqua Fortis, and re-swilling in water, which should render the article quite bright. Put the article into the Bronzing Solution, and move continually until it becomes a uniformly dark colour. When taken out, swill through clean water, then put into hot water (almost boiling); this will improve the colour.

The article should then be scratch-brushed, passed through the Solution again until the desired colour is obtained. Then swill in water as before, and dry the article out in boxwood sawdust, then lacquer. The scratch-brush or knot should not be too fine.

This Solution should be well covered over when not in use. Earthenware vessels with covers are recommended for this Solution.

Brown and Black on Brass. Articles made in Copper, Brass or Iron articles electro-copper plated, can be bronzed a light or dark brown down to a blue-black colour by using:—

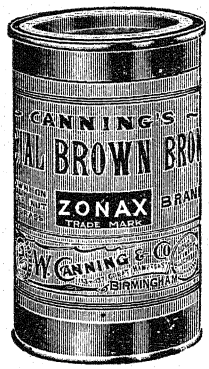
Sulphuret Potash—Zonax Brand..	2 to 4 ozs.
Water	1 gallon.

The water is put in an enamelled iron vessel and the Sulphuret Potash dissolved, the quantity of the latter depending on the depth of colour required. The Solution can be used cold or hot. The length of time it is left in the Solution deepens the colour. To darken the colour add a very small quantity of Liquid Ammonia ·880. After Bronzing the article should be scratch-brushed or polished on a Basil Mop with Peerless Polish, then lacquered.

Heat Solution to 180° Fahr.

This is very suitable for export where railway carriage is a consideration.

Brown Bronze on Copper-Plated or Coppered Articles. Take a small portion of the bronze and mix into a paste of the consistency of cream with equal parts of water and liquid ammonia ·880. Take a clean camel-hair brush, and well cover the article all over with the paste, not too thick or too thin. Then allow to dry. When dry brush the article briskly with either a soft Brass wire hand scratch-brush, or a soft circular Brass wire scratch-brush if used on a lathe.



If a darker shade is required the article should be heated on a stove or hot plate after bronzing. After Bronzing the superfluous material is brushed off.

Another Brown Bronze on Copper, or Copper-Plated Articles. If the article is not of Copper it must be plated in a Sulphate Copper solution for about five minutes, then treated exactly as above (see p. 220).

If the article is not dark enough the process should be repeated, and then the articles lacquered in the usual way.

Antique Brass. The article is first rubbed with Powdered Pumice, damped with water, immersed for a few seconds in a solution as follows :—

Nitrate Copper	1 lb.
Hydrochloric Acid	1 lb.
Water	1 gallon.

Place the solution in an enamelled iron vessel and heat to about 180° Fahr.

After the article is taken out, place it on a stove or hot plate without swilling ; when dry, brush *very lightly* with a bristle brush.

It is important to place the article on the stove as it leaves the Solution without swilling.

Dark Brown to nearly Black on Copper or Copper-Plated Articles.—

Hydrosulphide Ammonia (treble strength), "Zonax" Brand	4 ozs.
Water	1 gallon.

Heat the Solution to about 180° Fahr. in an enamelled iron vessel until the desired colour is obtained ; any shade between a dark brown and nearly black can be obtained. When the article is removed from the solution swill well in clean water and lightly scratch-brush, then swill and dry in clean Boxwood Sawdust, and Lacquer in the usual way.

The articles can be relieved by rubbing over with pumice stone, or on a Basil Leather or Cloth Mop with Lustre Polish.

This Bronze is largely used for Cabinet Brassfoundry, Fenders, Chandeliers, Electroliers, Fire Irons, and articles stamped in Tin, Copper-plated and relieved.

For articles which have to be done cheaply, the scratch-brushing can be dispensed with, and relieved on the Mop.

Iridescent Brown on Brass can be obtained by dissolving :—

2 lbs. Barium Sulphide in 1 gallon Water.

Place the Solution in an enamelled iron vessel and use boiling.

After the articles are cleaned in the usual way, they are immersed in the Barium Sulphide Solution until the desired colour is obtained. Then swill well in clean water, dry in Boxwood Sawdust, and Lacquer in the usual way.

Blue on Brass.—

Hyposulphite Soda	1 lb.
Acetate Lead	½ lb.
Water	1 gallon.

Heat the Solution in an enamelled iron vessel till boiling, then dip the article very quickly in the Solution till the desired colour is obtained, then swill well in clean water, and dry out in clean Boxwood Sawdust.

A different shade can be obtained on Copper, or articles Copper plated in a Sulphate Copper Solution, and treated as above. It is important that the article is lacquered immediately.

The better the article is polished, the better will be the colour.

Oxidising Silver or Silver-plated Articles. If the article is Silver-plated, the deposit must be heavy enough to withstand the action of the Oxidising Solution; after scratch-brushing immerse the article in a Solution of :—

Hydrosulphide Ammonia, "Zonax" Brand ..	4 ozs.
Water	1 gallon

Heat the Solution to 180° Fahr. in an enamelled iron vessel.

Another Solution is :—

Sulphuret Potash, "Zonax" Brand	4 ozs.
Water	1 gallon.

Heat the Solution to about 150° Fahr. in an enamelled iron vessel. Leave the articles in the Solution till the desired colour is attained, then swill in clean water, and dry out in clean Boxwood Sawdust.

Another shade can be obtained which is a light blue grey :—

Bichloride Platinum	¼ oz.
Water	1 gallon.

Use the Solution boiling, and allow the article to remain in till the desired shade is obtained. It is then ready for relieving on a soft Mop.

Another process for making Silver articles antique is as follows: After the articles have been put through the process of Silver-plating and finished, they are placed in an Electro-tinning Solution for about two minutes just to give the articles a film of Tin; the article is then either scratch-brushed on a soft brush, or brushed with a soft bristle brush and very fine powdered pumice, damped with water to give it a fine scratchy appearance.

Relief Bronzing. Pleasing contrasts can be obtained on a bronzed article by showing some parts of it in the natural colour of the metal. It can be relieved by hand in the following manner:—

Take some abrasive material, such as Powdered Pumice, and apply it by means of a damp cloth, rubbing those portions of the article where the bronze requires removing,

Another method is by the use of a Basil Leather Mop and Lustre Polish. Revolve on a polishing lathe, and apply those parts of the article which are required to be thrown into relief.

In the case of bronzing a cast-iron article having a deep recess, and which has been previously coppered or brassed, it is advisable to well scratch-brush it first. This procedure will assist the operator to obtain a uniform colour. If the article then requires relieving, it can be done by either of the two methods described above.

"Greeny Brown" on Brass can be obtained by dissolving in an Enamelled Iron Vessel

1 oz. (weight) Nitrate Copper.
1 oz. (measure) water.
Use warm, 120° to 150° Fahr.

The articles are cleaned and swilled in the usual way, then brushed repeatedly with the mixture, until the desired shade is obtained, and put on a stove or hot plate to dry. The process may have to be repeated. When the final colour is obtained, dry on stove again, and pass through fine Boxwood Sawdust. Finally brush the surface with French Chalk with a soft bristle brush, then lacquer.

Another shade of Antique Brass is obtained by using:

3 ozs. (weight) Nitrate Copper.
2 ozs. (weight) Hydrochloric Acid.
3 ozs. (measure) water.

The solution is placed in an earthenware vessel, and used at a temperature of 120° to 150° Fahr. The article is immersed in the solution until the desired shade is obtained, then well swilled in clean, cold water, dried in clean, hot Boxwood Sawdust, and finally lacquered.

Imitation Oxidised Silver. Brass articles are cleaned and swilled in the usual way, and immersed in Canning's Steel Bronze Solution for a few seconds, as described on p. 221. Then scratch-brushed on a Brass Wire Scratch-Brush, No. 553. Immerse in the Steel Bronze Solution again for a second or two, swill in clean, cold water, then in clean, hot water, and dry in clean, hot Boxwood Sawdust. Relieve the raised parts on a Basil Leather Mop or by hand. These relieved parts which are free from the Steel Bronze are then rubbed over with Canning's Silvering Salt. The salt is placed in a saucer and rubbed on, with a wet rag. Swill in clean cold water, then in clean hot water, and dry in clean hot Boxwood Sawdust, and brush up with a soft Bristle Brush, and finally lacquer.

Another method of producing imitation oxidised silver is to first electro tin the articles as described on p. 113. Then scratch-brush with

a Brass Wire Scratch-Brush, No. 553, and bronze in Canning's Steel Bronze solution, as described on p. 221. They are then suitably relieved and finally lacquered.

Satin Finish. To obtain a dull polished appearance on Brass and Copper articles, which is known as satin finish.

The article is first polished in the usual way as described, on p. 184 ; it is then brushed with a circular Brass Wire Scratch-Brush, No. 553 or 558 —for particulars see p. 132—or with a Circular Bristle Brush, No. 595 (the size of the brush depends on the shape and size of the article). The work should be brushed wet with a mixture of finely Powdered Pumice and water. The mixture should be of the consistency of thin cream, and should be allowed to drop on the brush just at that point where it comes in contact with the article. It is advisable to smear the article with a mixture of sand and water before brushing. The fineness or coarseness of the brush depends on the finish required. The article is then washed clean, dried in clean hot Boxwood Sawdust, and lacquered with Pale "Lactrene," Colourless "Thermolene," or "Frigilene."

Another method of obtaining satin finish on brass work: after the article has been polished in the usual way, including colouring, it is brushed with a circular white Hog-Hair Brush either No. 63R or 63S with powdered pumice, 120 grade. The pumice is mixed with a mineral lubricating oil and fed on to the brush as described above.

Frosting Aluminium. Aluminium can be frosted in the following manner: 1. *For Bright Frosting.*—The article is first polished as described on p. 185. Then brushed (dry) with a scratch-brush, as No. 570, made of steel wire. The finish of the article depends upon the wire of the brush —the finer or coarser the wire, the finer or coarser the finish.

2. For a more milky appearance of frosting, the Aluminium article is simply immersed in our Aluminium Frosting Solution No. 767, which is worked warm at about 180° Fahr. The article is immersed until the desired appearance is obtained, swilled in clean water, and dried in Boxwood Sawdust.

LACQUERING METALS.

The Successful Application of Lacquer.

CLEANLINESS—absolute freedom from grease, dirt, or stains—is necessary to successful lacquering ; the prevalence of either means "lacquer peeling off," clouds, streaks, spots, etc. When using a Cold Lacquer it is particularly necessary to remove all grease from the articles before lacquering, and the articles must be wiped over with a Cleansing Fluid, or if more greasy and indented, immersed in a hot cleaning solution of Canning's Lyco (6 ozs. Lyco to 1 gallon of water), well swilled in *clean* cold water, then in *clean* hot water, then dry in *clean* Hot Boxwood Sawdust, and brush off loose sawdust with a soft sawdust brush, see No. 01294 (uneven embossed surfaces should be brushed). As little time as possible should pass between the removal from the cleaning solution and the lacquering process.

Where Cyanide or other chemicals are used in deposition (which attack and lodge themselves in the pores of the metal), extra care must be exercised in the swilling and the drying of the article. A non-homogeneous article requires quite a different treatment than a perfectly homogeneous piece of metal. As is well known, the chemicals referred to assert themselves usually within twenty-four hours; it is wise then to allow such work to remain at least a day before being lacquered, and if the surface impurities are noticeable the work should be stoved for several hours (which should develop the imperfections), then the final process of finishing (polishing) or scratch brushing will remove such and reduce the danger of the reappearance of spots to a minimum.

Too much care cannot be taken with regard to the water used in swilling; wherever possible, use water from the usual mains, and not that which has passed through any process in the works. The reasons are obvious—viz., freedom from impurities, for instance, water from boilers and the like, invariably has evidence of acids, salts, etc., abstracted from chemicals used to prevent "boiler scale."

Repetition regarding cleanliness must be admitted on account of its importance. When it is considered for a single moment, the expenses of beautiful designs, the polishing, finishing, plating, and other important processes through which the work passes, the final one—lacquering—has many important consequences, the main two being (first) impression on the buyer, and (second) the ultimate results in sustaining satisfactorily the effort and expense the manufacturer has bestowed on the production. This question of perfect cleanliness cannot be lightly treated, and it must always be remembered the power of Lacquer as a cleanser is considerable; it will sooner or later attack the grease, and when these two meet, the result is invariably shown in unsightly clouds, streaks, spots, etc. Uneven and matted surfaces, as is known, encourage grease, and require more stringent treatment than plain surfaces. Therefore, if the application of Lacquer is to be successful, the method of cleaning must be properly carried out, details of which have already been given. The time of immersion in the cleaning Solution is decided by the class of work being dealt with; plain surfaces do not require so long an immersion as uneven ones; brushing is unnecessary in the former, but recommended in the latter. "Lyco" Solution should not be allowed to get on the worker's hand.

We would draw special attention also to the care necessary in frequently cleaning the vessels used in the many processes through which the work passes. As far as possible, separate vessels should be used for each Solution or Lacquer, but if this is inconvenient, then every trace of the previous liquid should be removed before another is put in. Care should be taken to see that *no* Lacquer left in the basin is poured back into the stock bottle; the contents of the basin should be poured into a separate bottle, and used first when beginning again.

This point again raises the question as to the working conditions surrounding the lacquering process. This should be conducted entirely separately from any other, and as far away as practicable, as the prevalence of Plating Solution, Acid Dipping Process, and Casting shop fumes, undoubtedly brings disaster to results; these atmospheric "enemies"

quickly lodge themselves upon the work, and subsequent trouble is almost sure to occur. A perfect lacquering room should have roof ventilation, the higher the roof the better; if impracticable, the ventilation should be as high as possible. The ordinary door or window ventilation is an opponent to successful lacquering. The atmosphere surrounding the work should be as little disturbed as possible, and of course the room kept as free from dust as possible. Tanks for holding Dipping Lacquers are recommended to be of Enamelled Iron, Stone or Earthenware.

The main objects of Lacquering are:—To preserve the "finish" obtained as it leaves the producer; to prevent the injurious attacks of atmospheric impurities; to prevent the discoloration of the metal, and to increase rather than diminish the brilliancy of any natural colour of the metal. These results cannot be obtained without the proper lacquer, containing all the resisting qualities which are found in "Lactrene," "Thermolene," "Frigilene," etc., etc. The very fact of a thin surface film having such responsibilities emphasises the question of quality more than any descriptive words can imply.

Therefore the efforts of ourselves as Lacquer Manufacturers and the application of the lacquer to the article are inseparable if good results are desired, and when the assistance of the former is required it will be willingly given.

The continuity of quality also enters largely into the business—a lacquer manufactory must be so equipped to secure this—a point fully appreciated by us, both in the purchase of raw materials, and in such quantities as to guarantee perfect repetition in application and of scientific principle in manufacture.

There are practically now three classifications of lacquer—namely, Brush Dip and Spray. The use of the former is generally upon large surfaces which it is not convenient to dip, and especially in connection with high-class work where great care and attention is required. The brush lacquer is also recommended where the article is needed to be handled considerably, as it resists wear and tear much better than a dip lacquer. The lacquer is applied by special brushes, which are illustrated and described in Section 6 of our Catalogue.

The thinning of a brush lacquer should be carried out with the greatest care, as if too much of the thinner is used iridescence is caused; this difficulty also arises through using poor quality of lacquer. It will be seen from this that if the quality of the lacquer is all right a brush which will hold a reasonable quantity of lacquer should be used; in other words, if a flat brush is being used, a treble-filled brush is recommended in preference to a single-filled one, presuming, of course, that the surface of the work warrants its use.

In the case of dip lacquers, these are generally used for dealing with work in bulk, and where the question of cost enters.

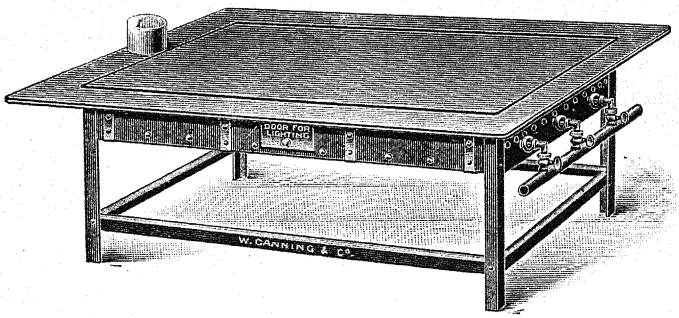
The subject of preparation of the work has been sufficiently emphasised, and the brief treatise may be concluded with a few references to the actual application of the lacquer.

HOT LACQUERING.

For Lacquering by Hot Process the requirements are :—

Lacquering Stove (*Catalogue, No.* 706).
Lacquer Basin (*Catalogue, No.* 750).
Lacquer Brushes (*Catalogue, Nos.* 704 or 705).
Lacquering Pliers.

Hot Lacquer is made in various grades, according to the quality of the ingredients and according to the quality of the work to be lacquered—telegraph work, electrical work, instrument work, etc., requiring the very highest grade possible, and cheaper work requiring cheaper lacquer. This lacquer is still most largely in use, and is used in connection with a lacquering stove where the work is heated, and then applied by brushing on the lacquer by a skilled operator in several coats. This lacquer requires the more skilled workmanship of any to secure regularity of colour and



Lacquering Stove.

freedom from rainbows. It is most generally used in all cases of small cabinet fittings, shop fittings, steam fittings, etc., etc.

It is most essential that the work be perfectly clean.

If the work has been burnished and dried out, it should be brushed with a soft brush (*See Catalogue, No.* 600), to remove any trace of sawdust which may have been left on it, and carefully wiped with soft rag or chamois leather.

If quite plain work has been *polished*, wipe with clean rag or chamois leather.

If ornamental or wrought work has been polished, wash in Petroleum or Methylated Spirits with soft brush to remove any trace of composition or grease, and dry out in clean boxwood sawdust. Carefully brush off sawdust, and wipe with clean rag or chamois leather.

Place the work upon the stove, and let it remain until it is well and equally heated all over. In the heating of the work there is no absolute rule as to temperature, but the usual heat is about 140° Fahr.; if the work is too hot the lacquer will "frizz," if too cold it will not adhere ;

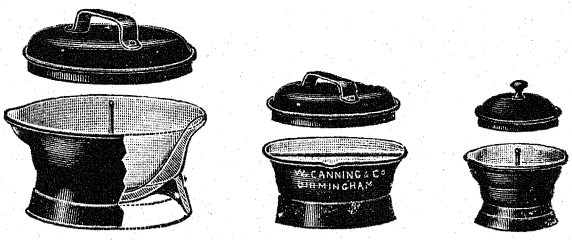
better to get it too hot than too cold, as the former can easily be cooled to the correct temperature.

Put into Lacquer Basin some of the Lacquer to be used.

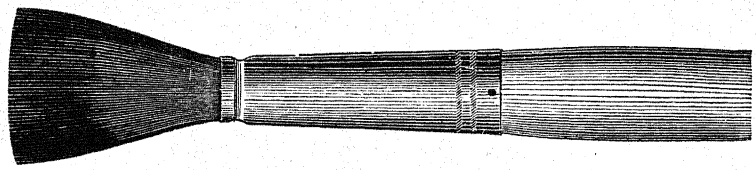
In taking up the Lacquer with the brush, dip brush well into the Lacquer and draw it over the wire which is stretched across the basin until all superfluous Lacquer is drawn off; this will leave sufficient Lacquer in the brush.

Care must be taken that no Lacquer should *run* from the brush on the work.

Draw work from stove. If small articles, take up with pliers, pass the brush (filled as above) quickly and lightly to and fro over the work. If the heat is correct, the Lacquer should dry as the brush passes over the



LACQUERING BASINS, No. 750.



LACQUER BRUSH. (SEE SECTION 6.)

work, each pass leaving a coat of Lacquer (take up more Lacquer in brush as required), and the work will assume a glossy or varnished surface, which will set hard as the work cools.

If a large piece of work, draw to edge of stove and Lacquer as above. Turn it over or move it with pliers. Do not touch work with hands during process of Lacquering until it is quite cold.

Flat Camel-hair Brushes (*Catalogue, No.* 0410) are recommended for general use.

Dip Lacquering.

Articles which are not Burnished, such as Chandelier and other Chains, Rings, Hooks, Capsules, etc., may be placed in Dipping Baskets (*Catalogue, No.* 301), or on wires, and Lacquered by Dipping Process.

For this purpose we recommend a deep Stoneware Pan (*Catalogue, No.* 313), with cover to keep clean and prevent evaporation. Put into pan sufficient Lacquer to cover the basket holding the articles, heat the articles on the stove till they are about 120° Fahr., place the articles in a wire dipping basket, No. 323; sling the basket and articles into the

Lacquer, *withdrawing the basket instantly*, before the articles in the basket cool. Shake the basket well whilst inside pan, and when drained turn out the articles on to a piece of paper spread out on the top of the hot stove; this ensures them being quite dry and brightens the coating of lacquer.

The results obtained depend entirely upon the operator.

For this purpose Pale Shell Lacquer answers well; but should a deeper colour be required add a *little Gold* Lacquer.

To Lacquer Tubes.

Tubes of any length may be heated for Lacquering by passing a jet of steam into one end. In its passage the steam will render the whole length sufficiently hot to make the Lacquering Process a success, or heated by electric current, or over a Bunsen Gas Burner.

In a Lacquering room where a steam jet is unavailable a simple method is to use an ordinary tea-kettle, which may be placed on the Lacquering or Heating Stove, and one end of the Tube put over the spout of the kettle. The cover of the kettle should fit tightly, and it will be found that the generated steam will raise the heat of the Tube to that required for good Lacquering.

Hold the Tube with a piece of clean rag in the left hand, pass the Lacquer Brush the lengthway of Tube for about 6 or 7 inches, and turn the Tube with each stroke until it is Lacquered all round, then pass on to a further 6 or 7 inches until the whole length of Tube is finished.

The various Lacquers are suitable for work as undermentioned:—

Pale Shell for Stamped Shell Work, Dipped Work, and anything upon which a gloss and protection is required; but the work will be little, if any, darker than before Lacquering.

Pale Gold for work as above, also suitable for Bronzed and Relieved Work, Chandeliers, Door Furniture, etc., etc.

Gold for Polished or Burnished Surfaces.

Deep Gold for a rich tint suitable for Brass Hinges, Door Handles, Plain Lamp Work, etc.

Orange Gold for Rich Wrought and Polished Work, Chandeliers, Electroliers, and Electric Fittings.

Amber for Drawer Handles, Cabinet Work, etc., etc.

Green for Bronzed (Steel and Antique) Work and Iron Work.

A rich effect is produced on work that has been Bronzed and Relieved by Lacquering all over with PALE SHELL or PALE GOLD Lacquer. Re-heat and lightly Lacquer burnished parts with Deep Gold, Orange or Amber.

An indefinite number of intermediate effects may be produced by mixing the various Lacquers, according to the taste of the operator, or as any special work may require it.

We would advise a beginner to use Pale Shell Lacquer, and try the deeper tints as experience is gained; the richer Lacquers require greater care and delicacy in manipulation.

It is most important that the room used for Lacquering should be *clean* and free from dust, and of an even warm temperature.

Cleaning Lacquer Brushes and Basins, etc.

Brushes. Draw Brush over wire on basin until Lacquer is drained from it. Carefully arrange hairs so that they are left quite evenly; they will then dry and maintain their shape. On resuming work, the Brush will require softening, and to do this, take a piece of tissue-paper, fold it to make a small pad of six or eight thicknesses, place this upon stove, dip Brush in Lacquer, and draw it evenly over the heated paper until it becomes soft.

Basins. Always clean Basins each time they have been used. To do this, empty Lacquer from Basin, put into Basin a small quantity of water (about 1 tablespoonful), turn right over on the hot stove, leaving inverted Basin for a moment for the generated steam to soften the Lacquer, take up quickly and wipe with tissue-paper. This will leave Basin perfectly clean.

For Cold Lacquering, with "Frigilene" or "Thermolene," use a small Lacquer Basin (see our No. 750, 4 in.), which prevents excessive evaporation by using small quantities at a time.

Should the Lacquering Stove become coated or spotted with Lacquer, a Solution of Strong Soda Water used when Stove is hot will readily remove it.

COLD LACQUERING.

THIS process is exceedingly useful, and can be applied with good effect by a less expert operator than is required in using the Hot Lacquer. We supply it in many colours, and if the few instructions we give are carefully followed, the user cannot fail to obtain good results.

In using Cold Lacquers it is most essential that the room in which the process is carried on must be perfectly clean and free from dust. The article must also be perfectly clean and free from grease, as if for plating. To ensure this, pass the article through a Solution of Lyco, swill well in clean hot water, and dry in boxwood sawdust; or our Cleansing Fluid should be used to clean the work after it is polished; take some soft clean rag, moisten it with Cleansing Fluid and wipe the surface of the article, drying with a clean soft rag.

An even warm temperature should be maintained in the Lacquering Room.

For Lacquering with Cold Lacquer the following are required :—

Lacquer Basin (*Catalogue, No.* 750).
Lacquer Brushes (*Catalogue, Nos.* 699 or 700).
Lacquering Pliers.

The work should not be heated before Lacquering, neither should it be chilly, but about the same temperature as the hand.

Be sure that no current of cold, damp, or chilly air passes over the work, either during Lacquering or when drying.

All our Lacquers are sent out ready for use, and the Reducer Liquid supplied for each special Lacquer must only be used when the Lacquer hat been allowed to become thick from evaporation, then add only sufficiens to restore its original consistency.

If made too thin, the result will be iridescent. In this case add sufficient quantity of the original Lacquer, and apply a second coat, taking great care that the first coat is perfectly dry.

A second coat may be applied in any of the Lacquers, provided always that the first coat is perfectly hard and dry.

"Frigilene" brushes must not be used for "Thermolene" and *vice versa*, and they must be cleaned only in the special Reducers.

FRIGILENE
REG^{D} N^{O} 314960

A Celluloid Lacquer applied Cold by Dipping or Brushing, and put up in Tins.

"FRIGILENE" is water white, transparent, and does not reduce the gloss or lustre on polished work; when scratched it does not show chalky streaks.

The surface produced is so smooth, hard, and tough, it is proof against handling or exposure.

The immunity from injury by flies renders it most suitable for tropical climates.

"Frigilene" may be used on all classes of work, but is especially adapted for Silver, Electro-plated, Nickel-plated, and Oxidised Copper and Brass articles; self colour and satin finished Brass; also steel, having what is known as "armour bright" finish.

When employed as a Dipping Lacquer, the "Frigilene" should be put into an earthenware pan or an enamelled iron tank; after the work has been dipped in the "Frigilene" it should be held over the tank till the drip has ceased, and then hung up to dry. either in the room or in a stove heated to about 100° Fahr.

The drippings and bottoms must not be poured back into the original jar, but kept in a separate receptacle.

If the Brushing Method be adopted, the "Frigilene" must be applied as freely as possible, using the brush very lightly and merely to direct the flow of the Lacquer. If any pressure is put upon the brush, the Lacquer will be driven in front of it, leaving too thin a coating behind, and consequently iridescent colours will appear.

In case this happens a second coating may be given when the first is quite dry.

Engraved name-plates and memorial brasses with waxed letters may be Lacquered by brushing on very lightly, rapidly, once only, a thin coat of "Frigilene," and allowing it to dry; then repeat the operation

twice at intervals of about half an hour. It is most essential that the "Frigilene" should be brushed on once only, so as not to dissolve the wax.

"Frigilene" is made in coloured shades, but we do not advise its use owing to its great density. Coloured "Frigilene" is difficult to lay on evenly with the brush, and the result is frequently patchy, and a coloured dipping Lacquer will always show a deeper colour where the "drip" ceases.

Therefore, if a gold colour for brushing on is desired, we recommend our "Lactrene" for large articles and "Thermolene" for small articles; or if the articles can be readily dipped our Gold Stains in various shades are most suitable.

The method of using Gold Stain is as follows:—

Dip the articles in Colourless "Frigilene" and allow the Lacquer to thoroughly dry.

Have ready an earthenware pan containing sufficient Gold Stain to cover the articles, and another pan with an equal quantity of water in it. Dip the Lacquered articles in the Gold Stain, take them out immediately, and well swill them in the water.

Dry off the water by gently patting the work with a soft clean cloth, and then hang in a warm stove (about 120° Fahr.) for a few minutes. Do not *rub* the articles while damp, or the Lacquer will be removed.

The result is a good imitation of Gilding.

THERMOLENE
REGD Nº 314981

A Cold Lacquer.

SHOULD be applied to the unheated article. Will dry in the air, but drying may be hastened by placing the work on the ordinary lacquering stove. The coat is hard, brilliant, and waterproof. It should be brushed on, not dipped (except the colourless, which can be dipped).

Fill the brush with "Thermolene," draw it lightly across the wire in the basin, and then apply freely, carefully noting that no part of the work is left uncoated.

As "Thermolene" is a quick-drying Lacquer, it is especially suited for all small Brassfoundry.

We are always pleased to match any shade required on receipt of pattern or specification.

If "Thermolene" works thick, it must be thinned with our Special Reducer, or Lacquer will be spoilt.

When requiring to clean brushes, rinse in the Reducer and not in Methylated Spirit.

"Thermolene" is made in the following shades: Pale Gold, Gold, Deep Gold, Antique Green, Amber, Steel Blue, Real Green, Orange, Ruby, or any other shade required.

Colourless "Thermolene" is useful for "satin-finished" Brass, Oxidised Silver, or any work which requires protection without changing the colour.

LACTRENE
REGD Nº 315641.

A Lacquer applied Cold, then Stoved.

"LACTRENE" is a New Lacquer with distinctive features to the old Cold Lacquers in use during the last few years.

Owing to its slow drying property, large work can be lacquered without fear of joining marks and without fear of brush marks.

It is a Non-celluloid Lacquer and has no objectionable smell.

It is the best Lacquer for bedsteads and large brass articles.

For all flat polished surfaces, such as Brass Fire Curbs, Square Tubes, etc., it is especially suitable, as it shows no brush-marks, and does not obscure the polishing.

Instructions for Using Canning's "Lactrene" Stoving Lacquer.

Canning's "Lactrene" is applied to the article cold with the best quality Camel Hair Brush. Before applying the "Lactrene" it is essential

that the surface of the article be clean and free from all grease, and where it is impracticable to put the article in a solution of "Lyco" to remove the grease, our Cleansing Fluid can be used to clean the articles. After the article is polished take some *soft clean* rag, moisten it with Cleansing Fluid and wipe the surface of the brass article, drying it with a Chamois Leather. Apply the "Lactrene" with a *Camel* Hair Brush of a suitable size and shape evenly to the surface, putting it on freely, only take care it does not run in patches; apply while the article is cold, then put the article into an enclosed drying stove (free from gas fumes), No. 806.

illustrated on next page, a superheated steam or electric-heated stove can be used, which should be heated to about 230° Fahr., and the articles left in the stove till they are the same heat. The size and shape of the articles decides the time they have to be left in the stove—about three minutes' stoving will be found sufficient for light stamped brass articles, whilst heavy articles, as Bedstead Pillars, may require ten minutes. The articles must not be removed from the stove till they have reached the temperature of the stove; when cold the lacquer should be quite hard and free from smell—softness of the surface or objectionable smell shows the heating has been insufficient. When placing articles in the stove they should not be placed on the bottom, where the heat is greatest, but put on wire trays a few inches off the bottom, or if large articles are being treated they can be suspended in the stove with suitable hooks.

"Lactrene" can be applied with good effect by a less expert operator than is required for Hot Lacquering; therefore it is recommended for export where expert lacquerers are not available.

"Lactrene" is made in all shades, same colours as Hot Lacquers (see p. 230).

"Lactrene" is equally good for small articles as large ones.

"Lactrene" is suitable for Copper Articles as well as Brass.

Brushes used for "Lactrene" can be cleaned in Methylated Spirits.

GAS STOVE, No. 806, FOR STOVING LACQUER.

THE construction of the Stove is so arranged that the gas fumes pass between the inner and outer plates of the Stove, thus preventing any gas fumes coming into contact with the work.

Doors are provided at the front to allow the temperature of the Stove to be regulated according to the heat required. If the Stove has to be cooled down the operator opens the door and allows cold air to pass into the gas chamber, which cools the Stove.

The Stove is well made, having two fume chimneys, one for the gas, and the other connected to the inside of the Stove, which can be opened or closed.

The Stove is fitted with the latest type of Atmospheric Burner, which consumes the maximum amount of air with the minimum amount of gas.

EBONIDE.

A Dead Black Cold Lacquer.

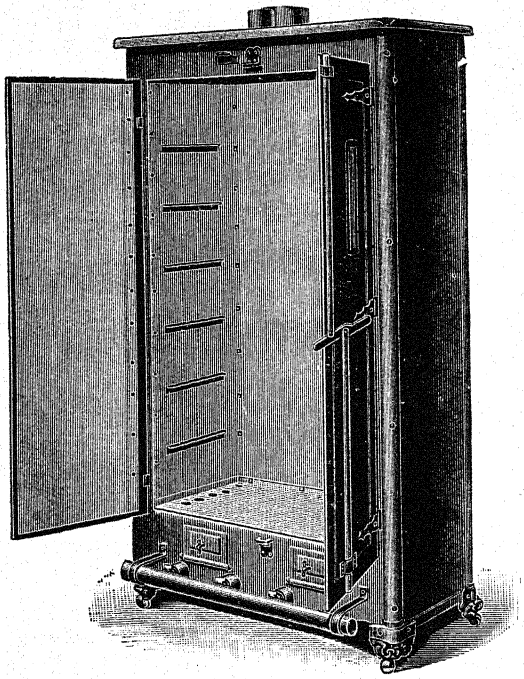
"EBONIDE" is a Quick-Drying, Hard and very Adhesive Black Lacquer, which gives a matt or dead finish to Iron, Brass and Wood articles. It may be applied by Dipping, Brushing or Spraying, and is suitable for Photographic Work, Ornamental Wrought Iron, Gas Fittings, Electrical Switch Fittings, etc.

Stoving is notabsolutely necessary, but a little heat will make the coating of Lacquer harder.

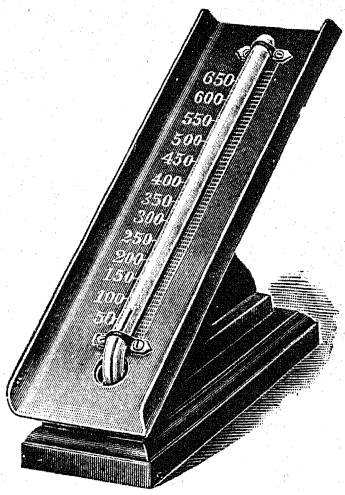
LACQUERING BASINS, No. 750.

In cast-iron, enamelled inside with finest white enamel. They cannot overturn owing to extended base, and are provided with spout for pouring and covers, if required.

They are clean, durable and safe (see p. 229).



Gas Stove, No. 806, for Stoving Lacquer.



Thermometer, No. 723.

THERMOMETERS.

For placing on top of Lacquering Stoves to ascertain the temperature.

COLOURED ELECTRIC LAMP LACQUER, No. 730.

Lamps are dipped in the Lacquer and dried by hanging in a warm stove, or by turning on the current.

Blue, Yellow, Ruby, Pink, Amber, Green, or any other colour.

To ensure the Lamps being quite clean and free from grease, it is well, before dipping them in the Lacquer, to swill them in Motor Spirit or Methylated Spirit, and wipe them dry on a clean soft cloth.

FROSTING LACQUER FOR ELECTRIC LAMPS.

Gives a perfect imitation of Sand Blasting, and applied as above.

LACQUER REVIVER.

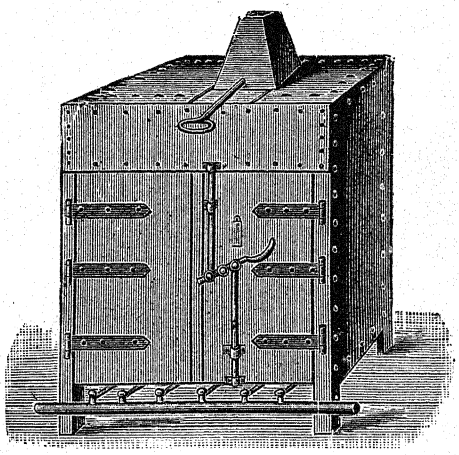
FOR wiping-up lacquered work in showrooms or stock, to revive the gloss and clear off fly-specks, etc. Moisten a soft cloth with the Reviver and lightly wipe the Brasswork, finishing off with a dry chamois leather.

ENAMELLING CYCLES.

ENAMELLING requires the utmost cleanliness, and no other work should be carried on in the same shop; the ceiling should be free from cracks, so as not to let the dust through.

A stove heated by gas is generally used; if same is not at hand, a stove heated by kerosene, fire, or hot steam pipes may be employed. Gas stoves being generally used, we illustrate this.

The Stove should be raised on a brick foundation about 6 ins. high. The space between the bottom of the Stove and ground at the back and sides should be filled up with brickwork or ironplate, but left open in front. This allows a proper inlet of air, which assists combustion. An outlet pipe should be fixed in the ventilator and connected with a chimney, if possible. Where the outlet pipe has to be taken into the open air a suitable cowl should be fixed to prevent back draught. Perfect ventilation with a free inlet for fresh air and a sufficient outlet for the fumes given off by the Enamel is of the greatest importance, as Enamel dries best in a dry heat. A badly-ventilated Stove causes Enamel to have a dull, "sleepy" appearance. It is also preferable to have the stove bricked in, to prevent the escape of heat, or use a Double Cased Stove filled with a non-conducting material between the inner and outer case. The main gas-pipe supplying the stove should be of sufficient diameter to give a good supply of gas, and care should be taken, when the stove is in use, that the gas burns with a non-luminous flame. If gas is burnt in the stove without a mixture of air, the flame will be smoky and less heat will be produced.



ENAMELLING STOVE.

It is preferable to have a sheet iron covering placed about 6 or 8 ins. over the gas flames to distribute the heat and prevent any of the lower parts of the article coming in contact with the flame.

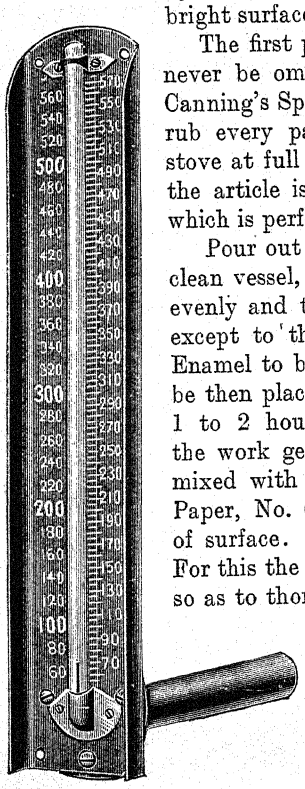
A Thermometer should be fixed in the door in the place provided for the purpose. The bent type, as illustrated, is best to use, as the bent

portion projects into the stove, and the heat in the centre of the stove is ascertained more correctly. It is, however, far better to test the actual heat of the Stove by an extra thermometer hung inside.

Compare the heat so registered with that shown on the door thermometer and register the difference for future guidance.

The difference is frequently from 20° to 60° Fahr. This is an important factor where white or delicate coloured Enamels have to be stoved.

A cycle frame having been well polished either on Polishing Bobs or by the use of Emery Cloth or Sand Paper, and having a perfectly smooth bright surface, free from all rust, is ready for Enamelling.



THERMOMETER.

The first process is that of "Sweating," which should never be omitted. To do this, dip a piece of rag in Canning's Special Tar Thinners, squeeze it out, and well rub every part of the work; then place in stove, and stove at full heat (say 380°) for 15 or 20 minutes. When the article is cold, it will be ready for the first coating, which is performed as follows :—

Pour out a little of the First Coating Enamel into a clean vessel, and with a flat Enamelling Brush apply it evenly and thinly to the whole surface to be Enamelled, except to the wheels. These are coated with a special Enamel to be mentioned afterwards. The article should be then placed in the stove and allowed to remain from 1 to 2 hours stoving at 300° Fahr. When dry, rub the work gently with the finest ground Pumice Stone mixed with water into a thin paste, or the finest Sand Paper, No. 0, wherever there is the slightest roughness of surface. It will then be ready for the second coat. For this the Finishing Enamel is used. Lay it on evenly, so as to thoroughly cover the work. If too much is put on, it will run and form lumps when placed in the stove, and also present here and there a shrivelled appearance, which cannot be remedied without entirely scraping off and beginning the work again as at first. Now turn up the full heat, and test the thermometer. The proper heat for the finishing coat is 300° Fahr., and the time to dry it is 1½ to 2 hours; but, whatever the time may be, the work must be left in the stove till there is the slightest sensation of tackiness on touching it while hot. If it be then removed or the gas turned out, it will be hard when cold. If exposed to the full heat till it is perfectly hard while hot the Enamel will be brittle and liable to chip when cold. Directly a piece of work is first coated, suspend it in the stove by hooks. When the stove is full, turn on the heat, care being taken not to give the full heat at once. (This applies more particularly to the Finishing Enamel.) For ordinary quality of work, the two coats will be sufficient, but if a superior finish is desired, the second coat must be gently rubbed

down with Powdered Pumice and Water, washed and dried, and another coat of Finishing Enamel applied as before. In applying the Enamel, avoid the "rubbing-on" style, but use a long steady stroke of the Brush in order to avoid air bubbles, which, if left on, sometimes cause a good deal of trouble when dry.

Enamelling by Pouring Over. So far we have treated of Enamelling by the Brush, but the process usually adopted where a large quantity of work is done is to pour the Enamel over the cycle frame as follows :—

The Enamel is placed in a small iron tank, having a tight-fitting lid to keep out the dust when not in use ; at one end of the tank a Sloping

ENAMELLING BRUSH.

Drip Board, covered with zinc, is erected, the size depending upon the quantity of work to be Enamelled. The cycle frame to be enamelled is rested on the Sloping Board, and the Enamel poured over with a small ladle such as an Enamelled Saucepan. When the Enamel has been poured all over, it is hung up over the Sloping Drip Board to drain ; it is best to plug the holes of the frame whilst the Enamel is poured over.

Enamelling by Dipping. If this method is adopted, an iron tank is used of sufficient size for the frame to be dipped, having a tight-fitting lid to keep out the dust ; the frame being plugged, it is dipped in the Enamel and allowed to drip over the Sloping Frame, as before described.

If the Enamel is too thick to run freely off the work when removed from the Vat, thin it with Thinning Spirit, but be careful not to add too much. The golden mean between too thick and too thin cannot be stated on paper, and must be learned by practice ; the work should drain for 10 to 15 minutes before being placed in the stove. When it has done dripping, remove with the fingers all blobs of Enamel which may have collected along the lower tubes. The position of frames whilst draining and in the stove is also very important. Care should be taken to suspend the frame so that the greatest possible number of tubes are at an acute angle ; this afcilitates the draining. It is also advisable to reverse the position of frame for each coat. This ensures greater evenness of Enamel; the heat should be about 300°. When dry, rub down lightly with the Powdered Pumice Stone and Water, and dip again as before.

In this process the dead First Coat Enamel used in the Brush Process may be dispensed with, but the work is improved by the application of the First Coating with a brush and stoving before pouring over the Finishing Enamel, experience going to prove that first-coated work is far less liable to the working-up of rust. The Finishing Enamel is not quite so dense, and two coats of it are not as black as one of the First Coating and one of Finishing.

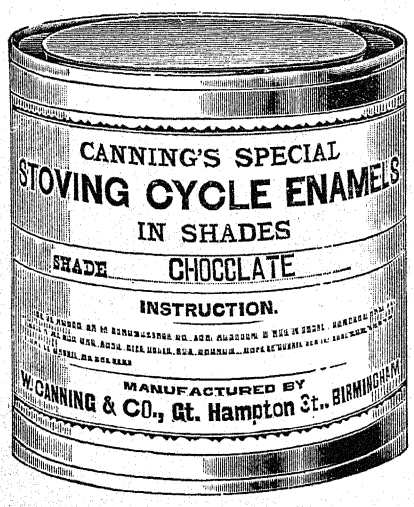
After this process the required decoration is put on, as in the case where brushing is adopted.

Lining and Decorating. Lines are drawn in the position desired with a Camel-hair Lining Pencil and Japanners' Gold Size.

When nearly dry, Gold Bronze Powder is rubbed on very lightly with a soft piece of wash leather. When quite dry, dust off the Bronze which is not required. Sometimes machines are required to be lined with gold. The Gold Leaf for this purpose is cut up into very narrow strips and applied on the Gold Size as the Bronze. But this process is difficult and wasteful in the hands of an inexperienced person.

Coloured lines, as Pale Yellow, Green, or Vermilion, are sometimes required. In this case squeeze out of the tube the Coach Builders' Colour (*see Catalogue, No.* 721) of the required tint, and mix it with equal parts of Gold Size and Turpentine. The lines are then drawn with this mixture, as explained above.

To Fix a Transfer. Carefully cut the Transfer from its sheet, and cut all round the pattern or design. Apply a thin coat of Transfer Varnish (*see Catalogue, No.* 719) to the face of the Transfer, and allow to stand from 15 to 20 minutes until the "tack" has nearly disappeared, then apply the Transfer face downwards to the frame in the required position, hold firmly, and press down firmly with a soft pad. Allow the Transfer to remain so for from 2 to 3 hours, then with a wet sponge well wet the back of the Transfer Paper, when it should easily be removed, leaving the design firmly attached to the frame. Lightly sponge off any gummy substance left, and allow the surface to dry.



Both Lines and Transfers when quite dry should receive a coat of Transfer-preserving Varnish (*see Catalogue, No.* 720), applied with a soft Camel-hair Brush, and have about one hour's stoving at 150°. The Varnish should only just cover the Lines or Transfers.

For Wheels having soft solder on, a special Enamel is prepared. It dries at less heat than the ordinary Enamel, and so the soft soldered

parts are not damaged or the Wheels buckled. It does not run down the spokes when placed in the stove, and thus the hub and rim are kept quite clean. It covers perfectly with one coat, and it is durable and flexible in wear. Dries at about 250° in 1¼ hours.

Bronzing Colours. Aluminium, Green, Blue, and various colours are used for covering the frames of Cycles after the frame is cleaned. The Bronze is mixed with very pale Mixing Varnish into a thin paste, applied to frame, and gently stoved at about 150° Fahr. for about one hour. Then it should receive a coat of Best Polishing Copal Varnish, and stoved for about one hour at 150° Fahr.

Another method is to apply a thin coat of Transfer Varnish and allow to stand for from 15 to 20 minutes. Then gently dust on the Bronze Powder and lightly rub in with a smooth chamois leather. After allowing to stand for an hour, varnish stove as described above.

A further method, in the case of Aluminium, is to give two coats of Canning's Ready Mixed Silver Stoving Enamel.

Polishing. Two coats at least of Finishing Enamel must be applied and stoved hard. The small lumps in the frame are removed by rubbing Lump Black Rottonstone over them: this must be done very carefully, not to scratch the enamel. Lump Black Rottonstone (*see Catalogue, No.* 721A) soaked in water in connection with a piece of Special Polishing Cloth is rubbed briskly over the surface till every brush mark, roughness, or irregularity is smoothed down, and the frame is wiped clean and dry. When the Enamel is quite smooth, Lump White Rottonstone (*see Catalogue, No.* 721C) is used for polishing up the Enamel as follows:—

Some White Rottonstone is rubbed on a dry board or slate into a fine powder, the palm of the hand slightly damped on a cloth lying at the side of the operator, then placed on a White Rottonstone; then rub the hand gently backwards and forwards over the surface till the desired amount of gloss is produced.

Coloured Work. Having thus described in detail the various processes required in Enamelling in Black, it remains to speak of Enamelling in Colours. For this purpose Coloured Enamels of various tints are manu actured. The only addition to them which may be required is a little Turpentine, to be added if the Enamel is too thick to lie smoothly. They are both Stoving and Self-drying Coloured Enamels, but the former are decidedly to be preferred for appearance and durability. Care must, however, be taken not to give more than 150° (and not more than 125° for White or very pale colours) in the stove, or the colours and the toughness will suffer. Two coats will usually be required, and the second one may be polished like the Black, if required. A better process, but one requiring some experience, is to give one or more coats of Ground Colour, which is rubbed down, and a final coat of Polishing Copal Varnish applied.

Notes to be Observed. Directly a frame is polished at the lathe it should be sweated, then have it first coated with Enamel; do not wait till it is rusty, and then be annoyed because you cannot get a good result. The longer the frame lies between Polishing Shop and Enamelling, the greater the liability for damp to settle in the metal, which damp, although

often imperceptible to the naked eye, is always liable to split Enamel off at some future period. Remember that damp and rust cannot work through the enamel from the outside; but if they are in the tube before it is Enamelled, they may cause the Enamel to fly afterwards.

Coloured Work. The lower the heat given the less danger of chipping.

Brushes. Always wash these out clean after use in Thinning Spirits. Keep a vessel for this purpose.

Removing Old Enamel. Before any part of a Cycle is Re-enamelled, the old Enamel must be removed by scraping, or the part can be put in a flame of gas for a short time, which will considerably help the removal of the old Enamel. The part to be Enamelled must be free from rust, dirt, or Enamel, and perfectly clean and bright.

Dust. Dust is the Enameller's greatest enemy. Keep everything free from dust and perfectly clean. When sweeping the floor of the Enamelling Shop, always sprinkle it well with water first, and sprinkle frequently to keep the dust from flying about.

Nearly every make of Enamel varies as to the time it has to be stoved and the temperature; therefore utilize care in this direction.

APPENDIX.

POLISHING AND FINISHING ENGLISH "GALALITH" AND "ERINOID."

First Process—Grinding and Polishing. The time occupied in this process is about 24 hours. The articles are placed in a wood Scouring Barrel, as illustrated on next page, revolving at a speed of 40 revolutions per minute. To every 100 pounds of articles should be added 10 to 15 pounds of powdered pumice and 2 pounds of shavings of the same material as to be polished.

When the articles are cleanly ground, they are sieved, washed in cold water, and well dried.

In place of washing and drying, however, the articles may, after being sieved, be revolved in another Barrel for about 10 hours, together with small rags soaked in ordinary machine oil. This latter process is an advantage, as it is an aid to the Polishing Process.

Second Process—Preliminary Polishing. Time required, about 8 hours.

The articles are now placed in another Barrel. To every 100 pounds of articles there should be added 10 to 15 pounds of coarse shavings of the same material as that to be polished, or fine wood sawdust, together with 2 to 5 pounds of stearine oil, well mixed, adding 5 pounds of finest polishing chalk. After the whole has been well mixed, place in the Barrel, together with the articles, and revolve from 8 to 10 hours.

Third Process—Fine Polishing. Time required, ½ to 1 hour. After the requisite preliminary polish has been obtained, the articles are well sieved, and placed in another Barrel to receive the final polish, the Barrel being filled up with small clean rags. A high polish is obtained in ½ to 1 hour.

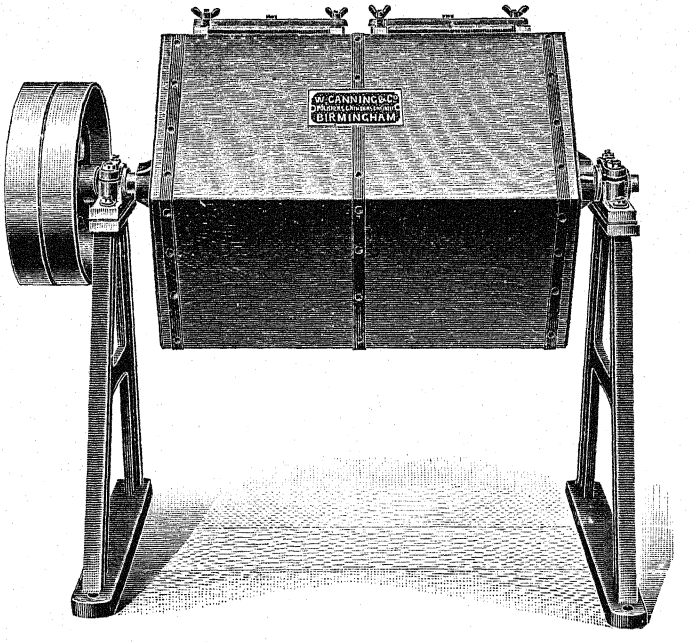
Note. It is recommended that the Barrels used in the Second and Third process are lined with felt.

RESISTANCE BOARDS.

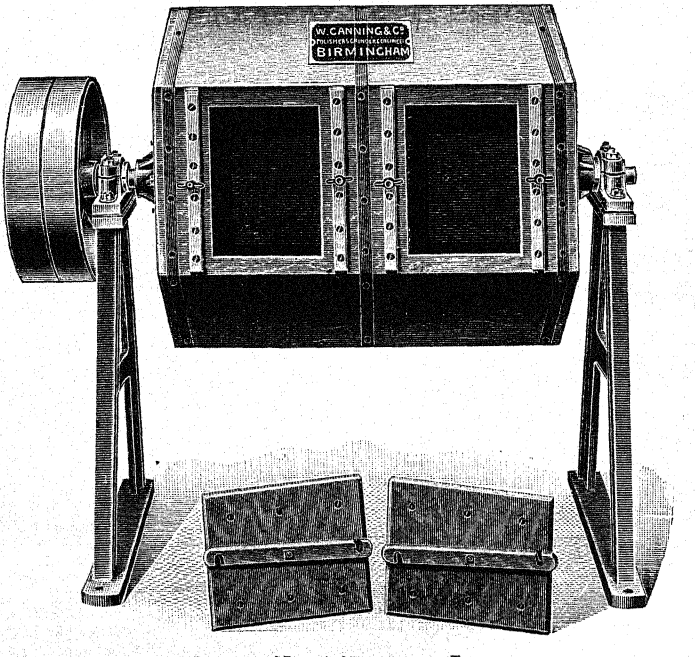
Resistance Boards are used to regulate the amount of current in a Vat, and all series resistances are operated in the same manner, although the electrical design and construction may be different.

When considering Resistance Boards, it is necessary to always remember one or two electrical conditions:

1. Every Plating Vat, when filled with work, has a certain resistance. This resistance can be decreased by **strengthening,** or increased by **impoverishing,** the Solution in salts.



POLISHING BARREL No. 1,077, WITH LIDS FIXED.



POLISHING BARREL No. 1,077, WITH LIDS REMOVED.

2. The resistance of a Plating Bath varies with the amount of work in the Vat—the less work, the higher the resistance of the Vat, and *vice versa*.

3. The resistance of a bath may alter with the same amount of work in, due to polarisation, hence the need for agitating, and rod-moving devices, for certain classes of plating, such as rapid heavy copper depositing.

The first point to consider regarding the most suitable Resistance Board is, what current would the Vat take if the full Dynamo Voltage were applied, and we suggest that where there are no instruments to measure the current, it is safer to consult us for the information, or buy a meter. Of course your own experience in similar circumstances may serve as a guide, but it must always be borne in mind that the maximum capacity of a Board is the current taken in the Vat, when the full Dynamo Voltage is applied. Many a Board has been burnt out by excessive current, although the actual current used has not been as much as the capacity of the Board: for instance, a 50 ampère Board will not carry 50 ampères on the 1st stud; it should only have to carry this current on the last stud, and a smaller current on the last but one, and so on, until the current should reach a predetermined minimum on the 1st stud. If a Board made to carry 50 ampères shows a reading of, say, 30 ampères on the 1st stud, it is fairly obvious that by the time the resistance is cut out (by moving the lever on to the last contact), that the current taken at the Dynamo Voltage is probably well over 100 ampères.

It is important to give the following information when a special Board is desired, such as when it is required to cut down to a certain voltage or current, or, when certain current readings are required at the contacts,

1. Voltage of Dynamo Lead Rods under normal working conditions —that is when the Vats are working.
2. Voltage on Vat which gives the best results.
3. Current taken in Vat when full, with the voltage as per particulars of No. 2.
4. Steps or drop in current desirable from contact to contact on Board.
5. Minimum current the Board is required to reduce to.

The Plater should make a point of understanding the general effect of using a Resistance Board in circuit with a Vat. To successfully illustrate this, we must take an imaginary Vat, which at a voltage of 2 takes a current of 10 ampères. Assuming the Dynamo is a 6 volt machine, a resistance is necessary, and we will also assume that by putting the lever on the 1st stud we get the required reading on the Ammeter—namely, 10 ampères—and on testing the Vat Voltage find it is 2 volts between Anode and Cathode. The natural question arises, what has become of the other 4 volts, and we will at once state that they have been dissipated in the form of heat, known to electrical engineers as C^2R losses, expressed in watts. By this we mean that, in this particular instance, the useful watts (current multiplied by volts) equal 20. The watts dissipated in the form of heat $= 10 \times 10 \times \cdot4 = 40$ watts, ·4 equalling the resistance of the Board; or, expressed in another way, lost volts × current passing = loss in watts = 40.

It will thus be seen that the actual result is best expressed in watts, and in the case in point only $\frac{1}{3}$ of the actual watts generated are actually used in the process of Electro-plating.

Further, if you take a Voltmeter reading between the rods of the Vat, and also the reading between the terminals of the Resistance Board, and add them together, the resultant figure is always approximately the voltage of the lead rods adjacent to that particular resistance. We say, approximately, because some voltage losses may be caused by dirty connections, etc.

Another point which in practice is rather confusing is that sometimes, although the resistance is being cut out, the current does not increase as expected, but this is always due to either lack of power, incorrect speed, a dynamo too small, polarisation, or the trouble may be due to what is perhaps the most common trouble, lead rods too small for the current they are to carry, and immediately the load is put on, the resistance of the rods is so great that it reduces the voltage (*i.e.*, the C^2R losses takes place as before explained), and therefore the current, in exactly the same manner as a Resistance Board, the result being losses in transmission, which in some cases would pay for new cables in a year.

ELECTRO-TINNING.

Old Cooking Utensils, such as tins, grids, etc., used in gas-cookers, may be renovated by Electro-tinning.

The old tins must first be cleaned in " Lyco " (see page 46) to remove any grease, swilled in cold water, and immersed in a pickle composed of 1 part commercial sulphuric acid, 10 parts water, well swilled in clean water, scoured with scouring sand, well swilled in clean cold water, when they are ready for the Tinning Bath.

The tins should remain in the Tin Solution for about 20 minutes. After they have been in 10 minutes, they should be taken out, swilled, scoured with scouring sand, swilled in clean cold water, and replaced in the Tinning Vat for a further 10 minutes.

They are then taken out, swilled in water, and scratch brushed (see page 132), or scoured with scouring sand, to brighten the deposit, swilled in hot water, and dried in clean hot boxwood sawdust.

COBALT PLATING

Cobalt is a silver-white metal which can be deposited direct on to Brass, Copper, Iron, Steel, Tin, etc. It can be rapidly deposited using a 6-volt Dynamo and a still vat used cold or hot; there are several recipes for solutions suitable for special purposes. A solution for general purposes that will be found satisfactory is made as follows:

Cobalt Sulphate	4½ pounds.
Sodium Chloride	2½ ozs.
Boric Acid	5 ozs.
Water	5½ pints.
Total Bath	(about) 1 gallon.

Dissolve the Boric Acid by boiling up in the water, then add the Sodium Chloride and stir well in; then add the Cobalt Sulphate and stir well till all is dissolved.

Use pure Cobalt Anodes.

Voltage: 6 volts.

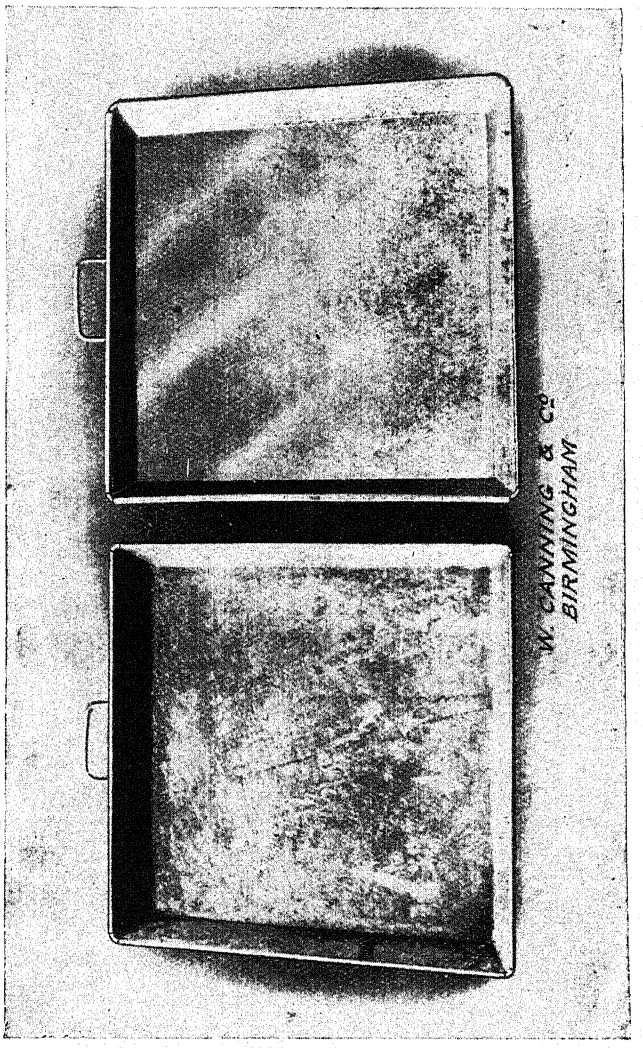


ILLUSTRATION OF OLD COOKING TIN, AND THE SAME TIN AFTER RENOVATION.

Current Density. 60 ampères per square foot.

Density. The solution will register 30° on our Nickelometer at a temperature of 60° Fahr.

Vat. This should be either Lead Lined with chemically pure lead, or Enamelled Iron or Earthenware if used Cold.

Cleaning. Articles must be prepared for plating by polishing and cleaning as for Nickel Plating (see page 47) to get first-class results.

After Plating, the articles can be mopped up to get a mirror-like bright surface, as after Nickel Plating (see page 184).

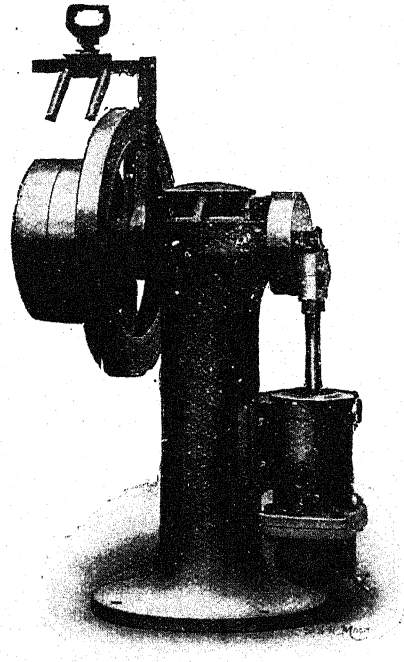
LACQUERING BY SPRAYING.

As Lacquering by Spraying is now becoming universal, a few notes here as to the apparatus necessary, the advantages, economy in time and labour, may not be out of place.

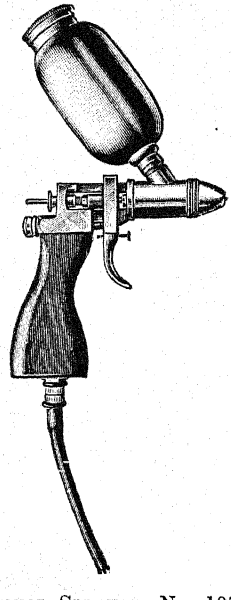
It has been proved by practice that the results obtained by Spraying are more effective than by the Brushing method, and being much quicker reduces the cost considerably. The coats of Lacquer are more durable and thorough at those parts which are difficult or impossible to reach with a brush, but which are thoroughly searched by the Spray. The necessary Spraying plant consists of an air compressor (Fig. 1020), to give a pure supply of air. This can be driven by means of a belt, or by an Electric Motor.

The Tank for storing the compressed air (Fig. 1055) should be fitted with pressure gauge, safety valve, and air cock. The articles are Spray Lacquered with a Pistol Sprayer (see Fig. 55), which is connected by flexible tubing to the air storing Tank (Fig. 1055).

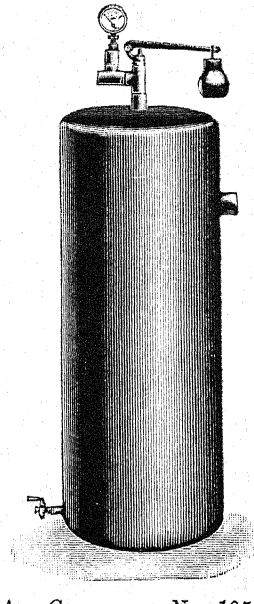
An arrangement of Exhaust-Fan has also to be fitted to remove the vapour made by the Spraying.



AIR COMPRESSOR, No. 1020.



PISTOL SPRAYER, No. 1058.



AIR CONTAINER, No. 1055.

USEFUL TABLES.

The following figures are intended as a guide to readers. They are taken from various sources, and we do not hold ourselves responsible for their accuracy:

WEIGHT AND THICKNESS OF METAL DEPOSITED BY A GIVEN CURRENT DENSITY.

	Weight deposited per hour with a Current of 1 Ampère.		*Thickness of Deposit produced in 1 hour with a Current of 1 Ampère per square inch.*
	Grammes.	*Grains.*	*Inch.*
Copper (Cyanide)	2·3665	36·520	·016208
,, (Sulphate)	1·1832	18·260	·008104
Gold	2·4410	37·670	·007721
Iron	1·0435	16·103	·007826
Lead	3·8571	59·525	·021134
Nickel	1·0994	19·966	·007894
Silver	4·0249	62·113	·023142
Tin	2·1988	33·932	·018414
Zinc	1·2112	18·691	·010415

Thus 10 ampères per square foot will deposit 11·832 grammes of copper (in Sulphate Solution) in 1 hour.

There being 28·35 grammes to an ounce, 11·832 grammes is equal to approximately 6·68 drachms or nearly $6\frac{3}{4}$ ounces.

If it is required to know what current is necessary to deposit a given thickness in a given time, say $\frac{1}{10}$ inch of copper in 24 hours in a Sulphate Copper Solution, with the assistance of the above table it will be found that a current density of $46\frac{1}{3}$ ampères per square foot will be required; thus, 144 ampères per square foot will deposit ·008104 nch in 1 hour, or ·06250 ($\frac{1}{16}$) in 7·71 hours.

If therefore 144 ampères deposits $\frac{1}{16}$ (·06250) in 7·71 hours, 46·3 ampères will be required to deposit the same thickness in 24 hours.

POWER.

To arrive at the cost of Power, the Board of Trade unit is 1,000 watts for 1 hour; thus a current of 500 ampères at 3 volts = 1,500 watts = $1\frac{1}{2}$ Board of Trade units at $1\frac{1}{2}$d. per unit = $2\frac{1}{4}$d.

If the efficiency of the dynamo is 75%, then the Power Consumption expressed in pence is 3d. per hour.

TABLE OF SPECIFIC GRAVITIES OF SOLUTIONS CORRESPONDING TO THE DEGREES OF CANNING'S NICKELOMETER, TWADDELL HYDROMETER AND BEAUME HYDROMETER.

Specific Gravity.	*Nickelometer.*	*Twaddell.*	*Beaume.*	*Specific Gravity.*	*Nickelometer.*	*Twaddell.*	*Beaume.*	*Specific Gravity.*	*Nickelometer.*	*Twaddell.*	*Beaume.*
1·000	0	—	0	1·175		35	—	1·388		—	41
1·005	—	1	—	1·176		—	22	1·390		78	—
1·007	1	—	1	1·180		36	—	1·395		79	—
1·010	—	2	—	1·185		37	23	1·400		80	—
1·014	2	—	2	1·190		38	—	1·401		—	42
1·015	—	3	—	1·195		39	24	1·405		81	—
1·020	3	4	3	1·200		40	—	1·410		82	—
1·025	—	5	—	1·205		41	25	1·414		—	43
1·028	4	—	4	1·210		42	—	1·415		83	—
1·030	—	6	—	1·215		43	26	1·420		84	—
1·034	5	—	5	1·220		44	—	1·425		85	—
1·035	—	7	—	1·225		45	27	1·428		—	44
1·040	—	8	—	1·230		46	—	1·430		86	—
1·041	6	—	6	1·235		47	28	1·435		87	—
1·045	—	9	—	1·240		48	—	1·440		88	—
1·049	7	—	7	1·245		49	29	1·442		—	45
1·050	—	10	—	1·250		50	—	1·445		89	—
1·055	—	11	—	1·255		51	—	1·450		90	—
1·057	8	—	8	1·256		—	30	1·455		91	—
1·060	—	12	—	1·260		52	—	1·456		—	46
1·064	9	—	9	1·265		53	—	1·460		92	—
1·065	—	13	—	1·267		—	31	1·465		93	—
1·070	—	14	—	1·270		54	—	1·470		94	47
1·072	10	—	10	1·275		55	—	1·475		95	—
1·075	—	15	—	1·278		—	32	1·480		96	—
1·080	11	16	11	1·280		56	—	1·485		97	48
1·085	—	17	—	1·285		57	—	1·490		98	—
1·088	12	—	12	1·289		—	33	1·495		99	—
1·090	—	18	—	1·290		58	—	1·500		100	49
1·095	—	19	—	1·295		59	—	1·505		101	—
1·096	13	—	13	1·300		60	34	1·510		102	—
1·100	—	20	—	1·305		61	—	1·515		103	50
1·104	14	—	14	1·310		62	—	1·520		104	—
1·105	—	21	—	1·312		—	35	1·525		105	—
1·110	—	22	—	1·315		63	—	1·530		106	—
1·113	15	—	15	1·320		64	—	1·531		—	51
1·115	—	23	—	1·324		—	36	1·535		107	—
1·120	—	24	—	1·325		65	—	1·540		108	—
1·121	16	—	16	1·330		66	—	1·545		109	—
1·125	—	25	—	1·335		67	—	1·546		—	52
1·130	17	26	17	1·337		—	37	1·550		110	—
1·135	—	27	—	1·340		68	—	1·555		111	—
1·138	18	—	18	1·345		69	—	1·560		112	—
1·140	—	28	—	1·349		—	38	1·562		—	53
1·145	—	29	—	1·350		70	—	1·565		113	—
1·147	19	—	19	1·355		71	—	1·570		114	—
1·150	—	30	—	1·360		72	—	1·575		115	—
1·155	—	31	—	1·361		—	39	1·578		—	54
1·157	20	—	20	1·365		73	—	1·580		116	—
1·160	—	32	—	1·370		74	—	1·585		117	—
1·165	—	33	—	1·375		75	40	1·590		118	—
1·166	—	—	21	1·380		76	—	1·595		119	—
1·170	—	34	—	1·385		77	—	1·596		—	55

COMPARISON OF CENTIGRADE AND FAHRENHEIT SCALES.

Fahr.	*Cent.*	*Fahr.*	*Cent.*	*Fahr.*	*Cent.*	*Fahr.*	*Cent.*	*Fahr.*	*Cent.*	*Fahr.*	*Cent.*
32	0	66	18·9	100	37·8	133	56·1	166	74·4	199·4	93
33	0·5	66·2	19	100·4	38	134	56·7	167	75	200	93·3
33·8	1	67	19·4	101	38·3	134·6	57	168	75·5	201	93·9
34	1·1	68	20	102	38·9	135	57·2	168·8	76	201·2	94
35	1·7	69	20·5	102·2	39	136	57·8	169	76·1	202	94·4
35·6	2	69·8	21	103	39·4	136·4	58	170	76·7	203	95
36	2·2	70	21·1	104	40	137	58·3	170·6	77	204	95·5
37	2·8	71	21·7	105	40·5	138	58·9	171	77·2	204·8	96
37·4	3	71·6	22	105·8	41	138·2	59	172	77·8	205	96·1
38	3·3	72	22·2	106	41·1	139	59·4	172·4	78	206	96·7
39	3·9	73	22·8	107	41·7	140	60	173	78·3	206·6	97
39·2	4	73·4	23	107·6	42	141	60·5	174	78·9	207	97·2
40	4·4	74	23·3	108	42·2	141·8	61	174·2	79	208	97·8
41	5	75	23·9	109	42·8	142	61·1	175	79·4	208·4	98
42	5·5	75·2	24	109·4	43	143	61·7	176	80	209	98·3
42·8	6	76	24·4	110	43·3	143·6	62	177	80·5	210	98·9
43	6·1	77	25	111	43·9	144	62·2	177·8	81	210·2	99
44	6·7	78	25·5	111·2	44	145	62·8	178	81·1	211	99·4
44·6	7	78·8	26	112	44·4	145·4	63	179	81·7	212	100
45	7·2	79	26·1	113	45	146	63·3	179·6	82	213	100·5
46	7·8	80	26·7	114	45·5	147	63·9	180	82·2	213·8	101
46·4	8	80·6	27	114·8	46	147·2	64·0	181	82·8	214	101·1
47	8·3	81	27·2	115	46·1	148	64·4	181·4	83	215	101·7
48	8·9	82	27·8	116	46·7	149	65	182	83·3	215·6	102
48·2	9	82·4	28	116·6	47	150	65·5	183	83·9	216	102·2
49	9·4	83·0	28·3	117	47·2	150·8	66	183·2	84	217	102·8
50	10	84	28·9	118	47·8	151	66·1	184	84·4	217·4	103
51	10·5	84·2	29	118·4	48	152	66·7	185	85	218	103·3
51·8	11	85	29·4	119	48·3	152·6	67	186	85·5	219	103·9
52	11·1	86	30	120	48·9	153	67·2	186·8	86	219·2	104
53	11·7	87	30·5	120·2	49	154	67·8	187	86·1	220	104·4
53·6	12	87·8	31	121	49·4	154·4	68	188	86·7	221	105
54	12·2	88	31·1	122	50	155	68·3	188·6	87	250	121
55	12·8	89	31·7	123	50·5	156	68·9	189	87·2	302	150
55·4	13	89·6	32	123·8	51	156·2	69	190	87·8	400	204
56	13·3	90	32·2	124	51·1	157	69·4	190·4	88	482	250
57	13·9	91	32·8	125	51·7	158	70	191	88·3	572	300
57·2	14	91·4	33·0	125·6	52	159	70·5	192	88·9	752	400
58	14·4	92	33·3	126	52·2	159·8	71	192·2	89	932	500
59	15	93	33·9	127	52·8	160	71·1	193	89·4	1112	600
60	15·5	93·2	34	127·4	53	161	71·7	194	90	1292	700
60·8	16	94	34·4	128	53·3	161·6	72	195	90·5	1472	800
61	16·1	95	35	129	53·9	162	72·2	195·8	91	1652	900
62	16·7	96	35·5	129·2	54	163	72·8	196	91·1	1832	1000
62·6	17	96·8	36	132	54·4	163·4	73	197	91·7	2282	1250
63	17·2	97	36·1	131	55	164	73·3	197·6	92	2732	1500
64	17·8	98	36·7	132	55·5	165	73·9	198	92·2	3182	1750
64·4	18	98·6	37	132·8	56	165·2	74	199	92·8	3632	2000
65	18·3	99	37·2								

MULTIPLIERS FOR AREAS, SURFACES, ETC.

Circles.

Circumference = Diameter multiplied by 3·1416.

Area = Square of the Diameter multiplied by 0·7854.

Radius = Half the diameter.

Other Figures.

Area of a Square = Length by breadth.

Area of a Triangle = ½ base × perpendicular height.

Rule to obtain Contents of a Rectangular Cistern. Multiply the length by the breadth and the product by the depth; the result multiplied by $6\frac{1}{4}$ will give the contents in gallons, there being about $6\frac{1}{4}$ gallons to one cubic foot.

Rule to obtain Contents of a Circular Cistern. Multiply the diameter by itself and deduct one-fifth from the product; then multiply the result by the depth and the result by $6\frac{1}{4}$, as for square cisterns.

Rule to calculate Speed and Diameters of Pulleys. Let "A" represent the diameter of the Driving Pulley; "B," the revolutions per minute of the Driving Pulley; "C," the diameter of the Driven Pulley; "D," the revolutions per minute of the Driven Pulley.

To find "D," multiply "A" by "B" and divide by "C."
To find "C," multiply "A" by "B" and divide by "D."
To find "B," multiply "D" by "C" and divide by "A."
To find "A," multiply "D" by "C" and divide by "B."

THERMOMETER SCALES.

To convert **Centigrade** or **Celsius** degrees into **Fahrenheit,** multiply the degrees by 9, divide by 5 and add 32. Thus 80° Centigrade or Celsius = 80 × 9 = 720 ÷ 5 = 144 + 32 = 176° Fahr.

Réaumur readings may be converted in the same way, substituting the figure 4 for 5; thus 80° Réaumur = 80 × 9 = 720 ÷ 4 = 180 + 32 = 212° Fahr.

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